



---

Junos<sup>®</sup> OS

# Ethernet Interfaces Feature Guide for Routing Devices

Release  
15.1



---

Modified: 2016-06-23

Juniper Networks, Inc.  
1133 Innovation Way  
Sunnyvale, California 94089  
USA  
408-745-2000  
[www.juniper.net](http://www.juniper.net)

Juniper Networks, Junos, Steel-Belted Radius, NetScreen, and ScreenOS are registered trademarks of Juniper Networks, Inc. in the United States and other countries. The Juniper Networks Logo, the Junos logo, and JunosE are trademarks of Juniper Networks, Inc. All other trademarks, service marks, registered trademarks, or registered service marks are the property of their respective owners.

Juniper Networks assumes no responsibility for any inaccuracies in this document. Juniper Networks reserves the right to change, modify, transfer, or otherwise revise this publication without notice.

*Junos<sup>®</sup> OS Ethernet Interfaces Feature Guide for Routing Devices*

15.1

Copyright © 2016, Juniper Networks, Inc.  
All rights reserved.

The information in this document is current as of the date on the title page.

#### YEAR 2000 NOTICE

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

#### END USER LICENSE AGREEMENT

The Juniper Networks product that is the subject of this technical documentation consists of (or is intended for use with) Juniper Networks software. Use of such software is subject to the terms and conditions of the End User License Agreement ("EULA") posted at <http://www.juniper.net/support/eula.html>. By downloading, installing or using such software, you agree to the terms and conditions of that EULA.

# Table of Contents

	About the Documentation . . . . .	xliii
	Documentation and Release Notes . . . . .	xliii
	Supported Platforms . . . . .	xliii
	Using the Examples in This Manual . . . . .	xliii
	Merging a Full Example . . . . .	xliv
	Merging a Snippet . . . . .	xliv
	Documentation Conventions . . . . .	xlvi
	Documentation Feedback . . . . .	xlvi
	Requesting Technical Support . . . . .	xlvi
	Self-Help Online Tools and Resources . . . . .	xlvi
	Opening a Case with JTAC . . . . .	xlvi
<b>Part 1</b>	<b>Ethernet Interfaces</b>	
<b>Chapter 1</b>	<b>Ethernet Interfaces Overview . . . . .</b>	<b>3</b>
	Ethernet Interfaces Overview . . . . .	3
	MX Series Router Interface Identifiers . . . . .	4
<b>Chapter 2</b>	<b>Performing Initial Configuration for Ethernet Interfaces . . . . .</b>	<b>5</b>
	Example: Configuring Fast Ethernet Interfaces . . . . .	5
	Example: Configuring Gigabit Ethernet Interfaces . . . . .	6
	Configuring Ethernet Physical Interface Properties . . . . .	6
	Configuring the Interface Speed on Ethernet Interfaces . . . . .	8
	Configuring the Ingress Rate Limit . . . . .	9
	Understanding Flow Control . . . . .	10
	IEEE 802.3X Ethernet PAUSE . . . . .	10
	Symmetric Flow Control . . . . .	10
	Configuring Flow Control . . . . .	11
	Configuring the Link Characteristics on Ethernet Interfaces . . . . .	12
	Configuring MAC Address Filtering for Ethernet Interfaces . . . . .	13
	Enabling Source Address Filtering . . . . .	13
	Configuring MAC Address Filtering on PTX Series Packet Transport Routers . . . . .	15
	MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview . . . . .	16
	Configuring Ethernet Loopback Capability . . . . .	17
	Ignoring Layer 3 Incomplete Errors . . . . .	18
	Configuring Gratuitous ARP . . . . .	18
	Adjusting the ARP Aging Timer . . . . .	19
	Configuring Weighted Random Early Detection . . . . .	20
	Configuring Multicast Statistics Collection on Ethernet Interfaces . . . . .	20

	Displaying Internal Ethernet Interfaces for a Routing Matrix with a TX Matrix Plus Router . . . . .	21
<b>Chapter 3</b>	<b>Configuring the Management Ethernet Interface . . . . .</b>	<b>25</b>
	Management Ethernet Interface Overview . . . . .	25
	Configuring a Consistent Management IP Address . . . . .	26
	Configuring the MAC Address on the Management Ethernet Interface . . . . .	27
<b>Chapter 4</b>	<b>Enabling Passive Monitoring on Ethernet Interfaces . . . . .</b>	<b>29</b>
	Passive Monitoring on Ethernet Interfaces Overview . . . . .	29
	Enabling Passive Monitoring on Ethernet Interfaces . . . . .	31
<b>Chapter 5</b>	<b>Configuring IEEE 802.1x Port-Based Network Access Control . . . . .</b>	<b>33</b>
	IEEE 802.1x Port-Based Network Access Control Overview . . . . .	33
	Understanding the Administrative State of the Authenticator Port . . . . .	34
	Understanding the Administrative Mode of the Authenticator Port . . . . .	34
	Configuring the Authenticator . . . . .	35
	Viewing the dot1x Configuration . . . . .	35
<b>Chapter 6</b>	<b>Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode . . . . .</b>	<b>37</b>
	802.1X for MX Series Routers in Enhanced LAN Mode Overview . . . . .	39
	How 802.1X Authentication Works . . . . .	39
	802.1X Features Overview . . . . .	40
	Supported Features Related to 802.1X Authentication . . . . .	41
	Understanding 802.1X and LLDP and LLDP-MED on MX Series Routers in Enhanced LAN Mode . . . . .	41
	Understanding 802.1X and RADIUS Accounting on MX Series Routers in Enhanced LAN Mode . . . . .	44
	Understanding 802.1X and VoIP on MX Series Routers in Enhanced LAN Mode . . . . .	45
	Understanding Guest VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode . . . . .	46
	Understanding Dynamic VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode . . . . .	47
	Understanding Server Fail Fallback and Authentication on MX Series Routers in Enhanced LAN Mode . . . . .	47
	Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode . . . . .	48
	Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode . . . . .	50
	Configuring LLDP-MED on MX Series Routers in Enhanced LAN Mode . . . . .	51
	Enabling LLDP-MED on Interfaces . . . . .	51
	Configuring Location Information Advertised by the Router . . . . .	51
	Configuring for Fast Start . . . . .	52
	Configuring LLDP on MX Series Routers in Enhanced LAN Mode . . . . .	52
	Enabling LLDP on Interfaces . . . . .	52
	Adjusting LLDP Advertisement Settings . . . . .	53
	Adjusting SNMP Notification Settings of LLDP Changes . . . . .	54
	Specifying a Management Address for the LLDP Management TLV . . . . .	54



Configuring Server Fail Fallback on MX Series Routers in Enhanced LAN Mode . . . . .	55
Understanding Captive Portal Authentication on the MX Series Routers . . . . .	56
Limitations of Captive Portal . . . . .	57
Understanding Authentication Session Timeout on MX Series Routers . . . . .	57
Authentication Process Flow for MX Series Routers in Enhanced LAN Mode . . . . .	58
Specifying RADIUS Server Connections on an MX Series Router in Enhanced LAN Mode . . . . .	60
Configuring Captive Portal Authentication on MX Series Routers in Enhanced LAN Mode . . . . .	61
Configuring Secure Access for Captive Portal . . . . .	61
Enabling an Interface for Captive Portal . . . . .	62
Configuring Bypass of Captive Portal Authentication . . . . .	62
Designing a Captive Portal Authentication Login Page on an MX Series Router . . . . .	63
Configuring Static MAC Bypass of Authentication on MX Series Routers in Enhanced LAN Mode . . . . .	65
Controlling Authentication Session Timeouts on an MX Series Router in Enhanced LAN Mode . . . . .	65
Configuring MAC RADIUS Authentication on MX Series Routers in Enhanced LAN Mode . . . . .	67
Example: Configuring MAC RADIUS Authentication on an MX Series Router . . . . .	68
Example: Setting Up Captive Portal Authentication on an MX Series Router . . . . .	73
Example: Connecting a RADIUS Server for 802.1X to an MX Series Router . . . . .	77
Example: Setting Up 802.1X in Conference Rooms to Provide Internet Access to Corporate Visitors on an MX Series Router . . . . .	79
Example: Configuring Static MAC Bypass of Authentication on an MX Series Router . . . . .	83
Example: Applying Firewall Filters to Multiple Supplicants on Interfaces Enabled for 802.1X or MAC RADIUS Authentication on MX Series Routers . . . . .	86
<b>Chapter 7</b>	
<b>Configuring Media Access Control Security (MACsec) . . . . .</b>	<b>91</b>
Understanding Media Access Control Security (MACsec) on MX Series Routers . . . . .	91
How MACsec Works . . . . .	91
Understanding Connectivity Associations and Secure Channels . . . . .	92
Understanding Static Connectivity Association Key Security Mode (Security Mode for Router-to-Router Links) . . . . .	92
Understanding MACsec Hardware Requirements for MX Series Routers . . . . .	93
Understanding MACsec Software Requirements for MX Series Routers . . . . .	93
Understanding the MACsec Feature License Requirement . . . . .	93
Configuring Media Access Control Security (MACsec) on MX Series Routers . . . . .	93
Configuring MACsec Using Static Connectivity Association Key Security Mode (Recommended for Enabling MACsec on Router-to-Router Links) . . . . .	95
Example: Configuring MACsec over an MPLS CCC on MX Series Routers . . . . .	99

## Chapter 8

<b>Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy</b>	<b>121</b>
Aggregated Ethernet Interfaces Overview	122
Platform Support for Aggregated Ethernet Interfaces	122
Configuration Guidelines for Aggregated Ethernet Interfaces	124
Configuring an Aggregated Ethernet Interface	126
Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers	128
Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles	129
Supported Platforms	130
Aggregated Ethernet Bundle with Mixed Rates and Mixed Modes on T Series Routers	130
Understanding Mixed Rates and Mixed Modes	130
Platform Support Matrix for Mixed Aggregated Ethernet Bundles	131
Guidelines to Follow When Configuring Aggregated Ethernet Bundles with Mixed Rates and Mixed Modes	132
Aggregated Ethernet Bundles with Mixed Rates on MX Series Routers	133
Understanding Mixed Rates	133
Supported Features	134
Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles	136
Configuring Mixed Rates and Mixed Modes on an Aggregated Ethernet Bundle on T Series Routers	136
Configuring Mixed Rates on Aggregated Ethernet Bundles on MX Series Routers	138
Example: Configuring Aggregated Ethernet Interfaces	139
Configuring Junos OS for Supporting Aggregated Devices	140
Configuring Virtual Links for Aggregated Devices	140
Configuring LACP Link Protection at the Chassis Level	141
Enabling LACP Link Protection	141
Configuring System Priority	142
Configuring the Maximum Links Limit	142
Configuring PPM on Junos Fusion	142
Configuring the Number of Aggregated Ethernet Interfaces on the Device	143
Configuring Aggregated Ethernet Link Speed	144
Configuring Aggregated Ethernet Minimum Links	145
Configuring Tagged Aggregated Ethernet Interfaces	146
Configuring Untagged Aggregated Ethernet Interfaces	147
Configuring LACP for Aggregated Ethernet Interfaces	148
Configuring the LACP Interval	150
Configuring LACP Link Protection	151
Enabling LACP Link Protection	152
Configuring LACP System Priority	153
Configuring LACP System Identifier	153
Configuring LACP administrative Key	153
Configuring LACP Port Priority	154
Configuring LACP Hold-Up Timer to Prevent Link Flapping on LAG Interfaces	154

Tracing LACP Operations .....	155
Sample Configuration for Configuring Aggregated Ethernet LACP on Tagged and Untagged Interfaces .....	155
Configuring Aggregated Ethernet Link Protection .....	156
Configuring Link Protection for Aggregated Ethernet Interfaces .....	157
Configuring Primary and Backup Links for Link Aggregated Ethernet Interfaces .....	157
Reverting Traffic to a Primary Link When Traffic is Passing Through a Backup Link .....	157
Disabling Link Protection for Aggregated Ethernet Interfaces .....	158
Example: Configuring Aggregated Ethernet Link Protection .....	158
Configuring Shared Scheduling on Aggregated Ethernet Interfaces .....	158
Configuring Scheduler on Aggregated Ethernet Interfaces Without Link Protection .....	159
Configuring Symmetrical Load Balancing on an 802.3ad Link Aggregation Group on MX Series Routers .....	160
Symmetrical Load Balancing on an 802.3ad LAG on MX Series Routers Overview .....	160
Configuring Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers .....	160
Configuring Symmetrical Load Balancing on Trio-Based MPCs .....	163
Example Configurations .....	165
Example Configurations of Chassis Wide Settings .....	165
Example Configurations of Per-Packet-Forwarding-Engine Settings .....	165
Understanding Aggregated Ethernet Load Balancing .....	166
Example: Configuring Aggregated Ethernet Load Balancing .....	168
Understanding Aggregated Ethernet Load Balancing .....	169
Example: Configuring Aggregated Ethernet Load Balancing .....	171
Stateful Load Balancing for Aggregated Ethernet Interfaces Using 5-Tuple Data .....	184
Guidelines for Configuring Stateful Load Balancing for Aggregated Ethernet Interfaces or LAG Bundles .....	186
Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces .....	187
Configuring Adaptive Load Balancing .....	188
Understanding Independent Micro BFD Sessions for LAG .....	189
Example: Configuring Independent Micro BFD Sessions for LAG .....	192
Configuring Multicast Statistics Collection on Aggregated Ethernet Interfaces .....	201
Deleting an Aggregated Ethernet Interface .....	202
Configuring Distributed Periodic Packet Management .....	202
Disabling or Enabling Distributed Periodic Packet Management Globally ..	203
Disabling or Enabling Distributed Periodic Packet Management for LACP Packets .....	203

<b>Chapter 9</b>	<b>Configuring Ethernet Automatic Protection Switching for High Availability . . . . .</b>	<b>205</b>
	Ethernet Automatic Protection Switching Overview . . . . .	205
	Unidirectional and Bidirectional Switching . . . . .	206
	Selective and Merging Selectors . . . . .	206
	Revertive and Nonrevertive Switching . . . . .	206
	Protection Switching Between VPWS Pseudowires . . . . .	206
	CLI Configuration Statements . . . . .	207
	Mapping of CCM Defects to APS Events . . . . .	208
	Example: Configuring Protection Switching Between Psuedowires . . . . .	209
<b>Chapter 10</b>	<b>Configuring Ethernet Ring Protection Switching for High Availability . . . .</b>	<b>213</b>
	Ethernet Ring Protection Switching Overview . . . . .	213
	Understanding Ethernet Ring Protection Switching Functionality . . . . .	214
	Acronyms . . . . .	214
	Ring Nodes . . . . .	215
	Ring Node States . . . . .	215
	Default Logging of Basic State Transitions on EX Series Switches . . . . .	215
	Failure Detection . . . . .	216
	Logical Ring . . . . .	216
	FDB Flush . . . . .	216
	Traffic Blocking and Forwarding . . . . .	216
	RPL Neighbor Node . . . . .	217
	RAPS Message Blocking and Forwarding . . . . .	217
	Dedicated Signaling Control Channel . . . . .	218
	RAPS Message Termination . . . . .	218
	Revertive and Non-revertive Modes . . . . .	219
	Multiple Rings . . . . .	219
	Node ID . . . . .	219
	Ring ID . . . . .	219
	Bridge Domains with the Ring Port (MX Series Routers Only) . . . . .	219
	Wait-to-Block Timer . . . . .	219
	Adding and Removing a Node . . . . .	220
	Configuring Ethernet Ring Protection Switching . . . . .	220
	Example: Ethernet Ring Protection Switching Configuration on MX Routers . . . .	221
<b>Chapter 11</b>	<b>Configuring MAC Address Validation on Static Ethernet Interfaces . . . . .</b>	<b>231</b>
	MAC Address Validation on Static Ethernet Interfaces Overview . . . . .	231
	Configuring MAC Address Validation on Static Ethernet Interfaces . . . . .	232
	Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors . . . . .	232
<b>Chapter 12</b>	<b>Configuring 802.1Q VLANs . . . . .</b>	<b>235</b>
	802.1Q VLANs Overview . . . . .	236
	802.1Q VLAN IDs and Ethernet Interface Types . . . . .	237
	Configuring Dynamic 802.1Q VLANs . . . . .	238
	Enabling VLAN Tagging . . . . .	239
	Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers . . .	241

Binding VLAN IDs to Logical Interfaces . . . . .	242
Associating VLAN IDs to VLAN Demux Interfaces . . . . .	246
Associating VLAN IDs to VLAN Demux Interfaces Overview . . . . .	246
Associating a VLAN ID to a VLAN Demux Interface . . . . .	246
Associating a VLAN ID to a Single-Tag VLAN Demux Interface . . . . .	246
Associating a VLAN ID to a Dual-Tag VLAN Demux Interface . . . . .	247
Configuring VLAN and Extended VLAN Encapsulation . . . . .	247
Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface . . . . .	248
Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance . . . . .	248
Specifying the Interface Over Which VPN Traffic Travels to the CE Router . . . . .	249
Specifying the Interface to Handle Traffic for a CCC . . . . .	249
Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface . . . . .	250
Specifying the Interface Over Which VPN Traffic Travels to the CE Router . . . . .	251
Configuring Access Mode on a Logical Interface . . . . .	252
Configuring a Logical Interface for Trunk Mode . . . . .	252
Configuring the VLAN ID List for a Trunk Interface . . . . .	253
Configuring a Trunk Interface on a Bridge Network . . . . .	253
Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance . . . . .	256
Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance . . . . .	256
Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface . . . . .	257
Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance . . . . .	257
Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit . . . . .	258
Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface . . . . .	258
Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs . . . . .	260
Guidelines for Configuring Physical Link-Layer Encapsulation to Support CCCs . . . . .	260
Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs . . . . .	260
Specifying the Interface to Handle Traffic for a CCC . . . . .	261
Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit . . . . .	262
<b>Chapter 13</b>	
<b>Configuring Private VLANs . . . . .</b>	<b>265</b>
Understanding Private VLANs on MX Series Routers . . . . .	265
Typical Structure and Primary Application of PVLANS . . . . .	266
PVLANS Use 802.1Q Tags to Identify Packets . . . . .	267
PVLANS Use IP Addresses Efficiently . . . . .	268
PVLANS Use Four Different Ethernet Switch Port Types . . . . .	268
Creating a PVLAN . . . . .	269
Bridge Domains Setup in PVLANS on MX Series Routers . . . . .	271

	Bridging Functions With PVLANS . . . . .	273
	Flow of Frames on PVLAN Ports Overview . . . . .	274
	Ingress Traffic on Isolated Ports . . . . .	275
	Ingress Traffic on Community ports . . . . .	275
	Ingress Traffic on Promiscuous Ports . . . . .	275
	Ingress Traffic on Interswitch Links . . . . .	275
	Packet Forwarding in PVLANS . . . . .	275
	Guidelines for Configuring PVLANS on MX Series Routers . . . . .	276
	Configuring PVLANS on MX Series Routers in Enhanced LAN Mode . . . . .	277
	Example: Configuring PVLANS with Secondary VLAN Trunk Ports and Promiscuous Access Ports . . . . .	279
	IRB Interfaces in Private VLANs on MX Series Routers . . . . .	291
	Guidelines for Configuring IRB Interfaces in PVLANS on MX Series Routers . . . . .	292
	Forwarding of Packets Using IRB Interfaces in PVLANS . . . . .	293
	Incoming ARP Requests on PVLAN Ports . . . . .	293
	Outgoing ARP Responses on PVLAN Ports . . . . .	294
	Outgoing ARP Requests on PVLAN Ports . . . . .	294
	Incoming ARP Responses on PVLAN Ports . . . . .	294
	Receipt of Layer 3 Packets on PVLAN Ports . . . . .	294
	Configuring IRB Interfaces in PVLAN Bridge Domains on MX Series Routers in Enhanced LAN Mode . . . . .	295
	Example: Configuring an IRB Interface in a Private VLAN on a Single MX Series Router . . . . .	297
<b>Chapter 14</b>	<b>Configuring Layer 2 Bridging Interfaces . . . . .</b>	<b>305</b>
	Layer 2 Bridging Interfaces Overview . . . . .	305
	Configuring Layer 2 Bridging Interfaces . . . . .	306
	Example: Configuring the MAC Address of an IRB Interface . . . . .	306
<b>Chapter 15</b>	<b>Configuring Link Layer Discovery Protocol . . . . .</b>	<b>315</b>
	LLDP Overview . . . . .	315
	Configuring LLDP . . . . .	316
	Example: Configuring LLDP . . . . .	319
	Tracing LLDP Operations . . . . .	320
<b>Chapter 16</b>	<b>Configuring VRRP and VRRP for IPv6 . . . . .</b>	<b>323</b>
	VRRP and VRRP for IPv6 Overview . . . . .	323
	Configuring VRRP and VRRP for IPv6 . . . . .	324
<b>Chapter 17</b>	<b>Configuring Point-to-Point Protocol over Ethernet . . . . .</b>	<b>327</b>
	PPPoE Overview . . . . .	328
	PPPoE Interfaces . . . . .	328
	Ethernet Interface . . . . .	328
	PPPoE Stages . . . . .	329
	PPPoE Discovery Stage . . . . .	329
	PPPoE Session Stage . . . . .	330

	Optional CHAP Authentication . . . . .	330
	Configuring PPPoE . . . . .	331
	Overview . . . . .	332
	Setting the Appropriate Encapsulation on the PPPoE Interface . . . . .	332
	Configuring PPPoE Encapsulation on an Ethernet Interface . . . . .	333
	Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface . . . . .	333
	Configuring the PPPoE Underlying Interface . . . . .	334
	Identifying the Access Concentrator . . . . .	334
	Configuring the PPPoE Automatic Reconnect Wait Timer . . . . .	334
	Configuring the PPPoE Service Name . . . . .	335
	Configuring the PPPoE Server Mode . . . . .	335
	Configuring the PPPoE Client Mode . . . . .	335
	Configuring the PPPoE Source and Destination Addresses . . . . .	335
	Deriving the PPPoE Source Address from a Specified Interface . . . . .	336
	Configuring the PPPoE IP Address by Negotiation . . . . .	336
	Configuring the Protocol MTU PPPoE . . . . .	336
	Example: Configuring a PPPoE Server Interface on an M120 or M320 Router . . . . .	337
	Disabling the Sending of PPPoE Keepalive Messages . . . . .	337
	Verifying a PPPoE Configuration . . . . .	337
	Tracing PPPoE Operations . . . . .	338
	Configuring the PPPoE Trace Log Filename . . . . .	339
	Configuring the Number and Size of PPPoE Log Files . . . . .	339
	Configuring Access to the PPPoE Log File . . . . .	339
	Configuring a Regular Expression for PPPoE Lines to Be Logged . . . . .	339
	Configuring the PPPoE Tracing Flags . . . . .	340
	Configuring the PPPoE Trace Log Filename . . . . .	340
	Configuring the Number and Size of PPPoE Log Files . . . . .	340
	Configuring Access to the PPPoE Log File . . . . .	341
	Configuring a Regular Expression for PPPoE Lines to Be Logged . . . . .	341
	Configuring the PPPoE Tracing Flags . . . . .	341
	Configuring the Severity Level to Filter Which PPPoE Messages Are Logged . . . . .	341
<b>Chapter 18</b>	<b>Configuring Restricted and Unrestricted Proxy ARP . . . . .</b>	<b>343</b>
	Restricted and Unrestricted Proxy ARP Overview . . . . .	343
	Restricted Proxy ARP . . . . .	343
	Unrestricted Proxy ARP . . . . .	343
	Topology Considerations for Unrestricted Proxy ARP . . . . .	344
	Configuring Restricted and Unrestricted Proxy ARP . . . . .	345
<b>Chapter 19</b>	<b>Configuring Static ARP Table Entries . . . . .</b>	<b>347</b>
	Static ARP Table Entries Overview . . . . .	347
	Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses . . . . .	348
<b>Chapter 20</b>	<b>Configuring TCC and Layer 2.5 Switching . . . . .</b>	<b>351</b>
	TCC and Layer 2.5 Switching Overview . . . . .	351
	Configuring VLAN TCC Encapsulation . . . . .	351
	Configuring Translation Cross-Connect Interface Switching . . . . .	353

<b>Part 2</b>	<b>Gigabit Ethernet Interfaces</b>	
<b>Chapter 21</b>	<b>Configuring 10-Gigabit Ethernet LAN/WAN PICs</b>	<b>357</b>
	10-port 10-Gigabit Ethernet LAN/WAN PIC Overview	357
	12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview	361
	24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview	363
	Modes of Operation of 10-Gigabit Ethernet PICs	365
	Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription	365
	Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC	366
	Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC	369
	Configuring Mixed-Rate Mode Operation	370
	P2-10G-40G-QSFPP PIC Overview	371
	Understanding Dual Configuration on P2-10G-40G-QSFPP PIC	372
	Port Numbering on P2-10G-40G-QSFPP PIC	373
	10-Gigabit Ethernet Mode	374
	40-Gigabit Ethernet Mode	375
	Configuring the P2-10G-40G-QSFPP PIC	375
	Configuring the PIC in 10-Gigabit Ethernet Mode or in 40-Gigabit Ethernet Mode	376
	Configuring the PIC in 10-Gigabit Ethernet Mode to Operate in 40-Gigabit Ethernet Mode	376
	Configuring the PIC in 40-Gigabit Ethernet Mode to Operate in 10-Gigabit Ethernet Mode	376
	Configuring Framing Mode	377
	Example: Configuring the P2-10G-40G-QSFPP PIC	378
<b>Chapter 22</b>	<b>Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength</b>	<b>381</b>
	Ethernet DWDM Interface Wavelength Overview	381
	Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength	381
<b>Chapter 23</b>	<b>Configuring 10-Gigabit Ethernet Framing</b>	<b>385</b>
	10-Gigabit Ethernet Framing Overview	385
	Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces	386
	Configuring 10-Gigabit Ethernet Framing	387
<b>Chapter 24</b>	<b>Configuring 10-Gigabit Ethernet Notification of Link Down Alarm</b>	<b>389</b>
	Gigabit Ethernet Notification of Link Down Alarm Overview	389
	10-Gigabit Ethernet Notification of Link Down for Optics Options Overview	389
	Configuring Gigabit Ethernet Notification of Link Down Alarm	390
	Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning	390
<b>Chapter 25</b>	<b>Configuring 40-Gigabit Ethernet PICs</b>	<b>391</b>
	40-Gigabit Ethernet PIC Overview	391
	Configuring 40-Gigabit Ethernet PICs	393



<b>Chapter 26</b>	<b>Configuring 100-Gigabit Ethernet PICs/MICs</b>	<b>395</b>
	100-Gigabit Ethernet Interfaces Overview	395
	100-Gigabit Ethernet	395
	MX Series 100-Gigabit Ethernet Interfaces	396
	PTX Series 100-Gigabit Ethernet Interfaces	396
	T Series 100-Gigabit Ethernet Interfaces	397
	MPC3E MIC Overview	397
	100-Gigabit Ethernet Type 4 PIC with CFP Overview	399
	Configuring 100-Gigabit Ethernet Type 4 PIC With CFP	402
	Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP	406
	100-Gigabit Ethernet Type 5 PIC with CFP Overview	408
	Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-ICGE-CFP	410
	Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP	411
	Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-ICGE-CFP and PD-ICE-CFP-FPC4	413
	Configuring SA Multicast Bit Steering Mode on the 100-Gigabit Ethernet PIC PF-ICGE-CFP	413
	Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 as One Aggregated Ethernet Interface	414
	Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4	415
	Configuring SA Multicast Bit Steering Mode on 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP	415
	Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 as One Aggregated Ethernet Interface	416
	Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength	417
<b>Chapter 27</b>	<b>Configuring Gigabit Ethernet OTN Options</b>	<b>421</b>
	Gigabit Ethernet OTN Options	421
	10-Gigabit Ethernet OTN Options Configuration Overview	422
	Understanding the P1-PTX-24-10G-W-SFPP PIC	423
	Interface Features	423
	Layer 2 and Layer 3 Features	425
	OTN Alarms and Defects	426
	TCA Alarms	427
	Configuring OTN Interfaces on P1-PTX-24-10G-W-SFPP PIC	427
	100-Gigabit Ethernet OTN Options Configuration Overview	430
	Understanding Pre-FEC BER Monitoring and BER Thresholds	431
	Configuring 100-Gigabit DWDM OTN PICs	435
	Supported OTN Options on PTX Series Routers	437
	Understanding the P2-100GE-OTN PIC	446
	Interface Features	446
	Layer 2 and Layer 3 Features	448

	OTN Alarms and Defects . . . . .	449
	TCA Alarms . . . . .	449
	Configuring OTN Interfaces on P2-100GE-OTN PIC . . . . .	450
<b>Chapter 28</b>	<b>Configuring Gigabit Ethernet Accounting and Policing . . . . .</b>	<b>455</b>
	Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs . . . . .	455
	Configuring MAC Address Accounting . . . . .	457
	MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview . . . . .	458
	Accounting of the Layer 2 Overhead Attribute in Interface Statistics . . . . .	459
	Guidelines for Configuring the Computation of Layer 2 Overhead in Interface Statistics . . . . .	460
	Configuring Layer 2 Overhead Accounting in Interface Statistics . . . . .	461
	Enabling the Accounting of Layer 2 Overhead in Interface Statistics at the PIC Level . . . . .	462
	Verifying the Accounting of Layer 2 Overhead in Interface Statistics . . . . .	462
	Configuring Gigabit Ethernet Policers . . . . .	465
	Overview . . . . .	465
	Configuring a Policer . . . . .	466
	Specifying an Input Priority Map . . . . .	466
	Specifying an Output Priority Map . . . . .	467
	Applying a Policer . . . . .	468
	Configuring MAC Address Filtering . . . . .	469
	Example: Configuring Gigabit Ethernet Policers . . . . .	470
	Configuring Gigabit Ethernet Two-Color and Tricolor Policers . . . . .	471
	Overview . . . . .	471
	Configuring a Policer . . . . .	473
	Applying a Policer . . . . .	473
	Example: Configuring and Applying a Policer . . . . .	474
<b>Chapter 29</b>	<b>Configuring Gigabit Ethernet Autonegotiation . . . . .</b>	<b>477</b>
	Gigabit Ethernet Autonegotiation Overview . . . . .	477
	Configuring Gigabit Ethernet Autonegotiation . . . . .	477
	Configuring Gigabit Ethernet Autonegotiation with Remote Fault . . . . .	478
	Configuring Flow Control . . . . .	478
	Configuring Autonegotiation Speed on MX Series Routers . . . . .	478
	Displaying Autonegotiation Status . . . . .	478
<b>Chapter 30</b>	<b>Stacking and Rewriting Gigabit Ethernet VLAN Tags . . . . .</b>	<b>483</b>
	Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview . . . . .	483
	Stacking and Rewriting Gigabit Ethernet VLAN Tags . . . . .	484
	Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames . . . . .	487
	Configuring Tag Protocol IDs (TPIDs) on PTX Series Packet Transport Routers . . . . .	488
	Configuring Stacked VLAN Tagging . . . . .	489
	Configuring Dual VLAN Tags . . . . .	489
	Configuring Inner and Outer TPIDs and VLAN IDs . . . . .	490
	Stacking a VLAN Tag . . . . .	493
	Stacking Two VLAN Tags . . . . .	494

	Removing a VLAN Tag . . . . .	494
	Removing the Outer and Inner VLAN Tags . . . . .	495
	Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag . . . . .	496
	Rewriting the VLAN Tag on Tagged Frames . . . . .	496
	Rewriting a VLAN Tag on Untagged Frames . . . . .	497
	Overview . . . . .	498
	Example: push and pop with Ethernet CCC Encapsulation . . . . .	500
	Example: push-push and pop-pop with Ethernet CCC Encapsulation . . . . .	500
	Example: push and pop with Ethernet VPLS Encapsulation . . . . .	500
	Example: push-push and pop-pop with Ethernet VPLS Encapsulation . . . . .	500
	Rewriting a VLAN Tag and Adding a New Tag . . . . .	501
	Rewriting the Inner and Outer VLAN Tags . . . . .	502
	Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags . . . . .	502
	Understanding Transparent Tag Operations and IEEE 802.1p Inheritance . . . . .	509
	Understanding swap-by-poppush . . . . .	511
	Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag . . . . .	511
<b>Part 3</b>	<b>Operation, Administration, and Management (OAM) for Ethernet Interfaces</b>	
<b>Chapter 31</b>	<b>Configuring IEEE 802.1ag OAM Connectivity-Fault Management . . . . .</b>	<b>517</b>
	Ethernet Operations, Administration, and Maintenance . . . . .	518
	IEEE 802.1ag OAM Connectivity Fault Management Overview . . . . .	519
	Connectivity Fault Management Key Elements . . . . .	521
	Best Practices for Configuring 802.1ag Ethernet OAM for VPLS . . . . .	522
	Continuity Check Protocol Parameters Overview . . . . .	523
	Creating a Maintenance Domain . . . . .	525
	Configuring Maintenance Intermediate Points (MIPs) . . . . .	526
	Creating a Maintenance Association . . . . .	528
	Configuring Continuity Check Protocol Parameters for Fault Detection . . . . .	529
	Configuring a MEP to Generate and Respond to CFM Protocol Messages . . . . .	530
	Configuring a Maintenance Association End Point (MEP) . . . . .	530
	Configuring a remote Maintenance Association End Point (MEP) . . . . .	532
	Configuring Service Protection for VPWS over MPLS Using the MEP Interface . . . . .	534
	Configuring a CFM Action Profile to Specify CFM Actions for CFM Events . . . . .	538
	Configuring Linktrace Protocol in CFM . . . . .	539
	Configuring Ethernet Local Management Interface . . . . .	540
	Ethernet Local Management Interface Overview . . . . .	540
	Configuring the Ethernet Local Management Interface . . . . .	542
	Configuring an OAM Protocol (CFM) . . . . .	542
	Assigning the OAM Protocol to an EVC . . . . .	542
	Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC . . . . .	542
	Example E-LMI Configuration . . . . .	543
	Example Topology . . . . .	543
	Configuring PE1 . . . . .	544
	Configuring PE2 . . . . .	545

Configuring Two UNIs Sharing the Same EVC .....	547
Configuring Port Status TLV and Interface Status TLV .....	548
TLVs Overview .....	548
Various TLVs for CFM PDUs .....	548
Support for Additional Optional TLVs .....	550
Port Status TLV .....	551
Interface Status TLV .....	553
MAC Status Defects .....	556
Configuring Remote MEP Action Profile Support .....	558
Monitoring a Remote MEP Action Profile .....	559
Configuring MAC Flush Message Processing in CET Mode .....	560
Configuring a Connection Protection TLV Action Profile .....	562
Example: Configuring an Action Profile Based on Connection Protection TLVs .....	563
Configuring M120 and MX Series Routers for CCC Encapsulated Packets .....	565
IEEE 802.1ag CFM OAM Support for CCC Encapsulated Packets Overview .....	565
CFM Features Supported on Layer 2 VPN Circuits .....	565
Configuring CFM for CCC Encapsulated Packets .....	566
Configuring Rate Limiting of Ethernet OAM Messages .....	566
Configuring Unified ISSU for 802.1ag CFM .....	569
Configuring Continuity Check Messages for Better Scalability .....	572
Configuring Faster Protection Switching for Point-to-Point Network Topologies .....	573
Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies .....	575
Configuring a Primary VLAN ID for Increased Flexibility .....	576
Configuring a Remote Maintenance Association to Accept a Different ID .....	577
Example: Configuring Ethernet CFM on Physical Interfaces .....	577
Example: Configuring Ethernet CFM on Bridge Connections .....	580
Example: Configuring Ethernet CFM over VPLS .....	583
<b>Chapter 32</b>	
<b>Configuring IEEE 802.3ah OAM Link-Fault Management .....</b>	<b>593</b>
IEEE 802.3ah OAM Link-Fault Management Overview .....	594
Configuring IEEE 802.3ah OAM Link-Fault Management .....	595
Configuring Ethernet 802.3ah OAM on PTX Series Packet Transport Routers ..	596
Enabling IEEE 802.3ah OAM Support .....	597
Configuring Link Discovery .....	598
Configuring the OAM PDU Interval .....	599
Configuring the OAM PDU Threshold .....	600
Configuring Threshold Values for Local Fault Events on an Interface .....	600
Disabling the Sending of Link Event TLVs .....	602
Detecting Remote Faults .....	602
Configuring an OAM Action Profile .....	603
Specifying the Actions to Be Taken for Link-Fault Management Events .....	605
Monitoring the Loss of Link Adjacency .....	606
Monitoring Protocol Status .....	607
Configuring Threshold Values for Fault Events in an Action Profile .....	608
Applying an Action Profile .....	609

	Setting a Remote Interface into Loopback Mode . . . . .	610
	Enabling Remote Loopback Support on the Local Interface . . . . .	611
	Example: Configuring IEEE 802.3ah OAM Support on an Interface . . . . .	612
	Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge . . . . .	613
	Example: Configuring Ethernet LFM for CCC . . . . .	615
	Example: Configuring Ethernet LFM for Aggregated Ethernet . . . . .	616
	Example: Configuring Ethernet LFM with Loopback Support . . . . .	618
<b>Chapter 33</b>	<b>Configuring ITU-T Y.1731 Ethernet Service OAM . . . . .</b>	<b>621</b>
	Ethernet Frame Delay Measurements Overview . . . . .	622
	ITU-T Y.1731 Frame Delay Measurement Feature . . . . .	623
	Ethernet CFM . . . . .	623
	Ethernet Frame Delay Measurement . . . . .	624
	One-Way Ethernet Frame Delay Measurement . . . . .	624
	1DM Transmission . . . . .	625
	1DM Reception . . . . .	625
	One-Way ETH-DM Statistics . . . . .	625
	One-Way ETH-DM Frame Counts . . . . .	625
	Synchronization of System Clocks . . . . .	625
	Two-Way Ethernet Frame Delay Measurement . . . . .	626
	DMM Transmission . . . . .	626
	DMR Transmission . . . . .	626
	DMR Reception . . . . .	626
	Two-Way ETH-DM Statistics . . . . .	626
	Two-Way ETH-DM Frame Counts . . . . .	627
	Choosing Between One-Way and Two-Way ETH-DM . . . . .	627
	Restrictions for Ethernet Frame Delay Measurement . . . . .	627
	Ethernet Frame Loss Measurement Overview . . . . .	628
	Service-Level Agreement Measurement . . . . .	630
	On-Demand Mode for SLA Measurement . . . . .	631
	Proactive Mode for SLA Measurement . . . . .	632
	Ethernet Delay Measurements and Loss Measurement by Proactive Mode . . . . .	633
	Ethernet Failure Notification Protocol Overview . . . . .	633
	Ethernet Synthetic Loss Measurement Overview . . . . .	634
	Scenarios for Configuration of ETH-SLM . . . . .	635
	Upstream MEP in MPLS Tunnels . . . . .	636
	Downstream MEP in Ethernet Networks . . . . .	636
	Format of ETH-SLM Messages . . . . .	637
	SLM PDU Format . . . . .	637
	SLR PDU Format . . . . .	638
	Data Iterator TLV Format . . . . .	638
	Transmission of ETH-SLM Messages . . . . .	639
	Initiation and Transmission of SLM Requests . . . . .	639
	Reception of SLMs and Transmission of SLRs . . . . .	639
	Reception of SLRs . . . . .	640
	Computation of Frame Loss . . . . .	640

Guidelines for Configuring ETH-SLM .....	641
Starting a Proactive ETH-SLM Session .....	642
Configuring MEP Interfaces .....	643
Configuring an Iterator Profile for ETH-SLM .....	644
Associating the Iterator Profile with MEPs for ETH-SLM .....	645
Starting an On-Demand ETH-SLM Session .....	646
Managing ETH-SLM Statistics and ETH-SLM Frame Counts .....	647
Displaying ETH-SLM Statistics Only .....	647
Displaying ETH-SLM Statistics and Frame Counts .....	648
Displaying ETH-SLM Frame Counts for MEPs by Enclosing CFM Entity . . .	648
Displaying ETH-SLM Frame Counts for MEPs by Interface or Domain Level .....	649
Clearing ETH-SLM Statistics and Frame Counts .....	650
Clearing Iterator Statistics .....	650
Troubleshooting Failures with ETH-SLM .....	651
Configuring an Iterator Profile .....	652
Verifying the Configuration of an Iterator Profile .....	654
Displaying the Configuration of an Iterator Profile for Two-way Delay Measurement .....	654
Displaying the Configuration of an Iterator Profile for Loss Measurement . .	655
Displaying the Configuration of a Remote MEP with an Iterator Profile . . .	656
Disabling an Iterator Profile .....	656
Managing Iterator Statistics .....	657
Displaying Iterator Statistics .....	657
Clearing Iterator Statistics .....	661
Configuring a Remote MEP with an Iterator Profile .....	662
Configuring Statistical Frame Loss Measurement for VPLS Connections . . . .	663
Guidelines for Configuring Routers to Support an ETH-DM Session .....	664
Configuration Requirements for ETH-DM .....	664
Configuration Options for ETH-DM .....	665
Guidelines for Starting an ETH-DM Session .....	665
ETH-DM Session Prerequisites .....	665
ETH-DM Session Parameters .....	666
Restrictions for an ETH-DM Session .....	666
Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts . . . .	667
ETH-DM Statistics .....	667
ETH-DM Statistics Retrieval .....	669
ETH-DM Frame Counts .....	669
ETH-DM Frame Count Retrieval .....	670
Frame Counts Stored in CFM Databases .....	670
One-Way ETH-DM Frame Counts .....	670
Two-Way ETH-DM Frame Counts .....	671
Configuring Routers to Support an ETH-DM Session .....	671
Configuring MEP Interfaces .....	671
Ensuring That Distributed ppm Is Not Disabled .....	673
Enabling the Hardware-Assisted Timestamping Option .....	674
Configuring the Server-Side Processing Option .....	675

Starting an ETH-DM Session . . . . .	675
Using the monitor ethernet delay-measurement Command . . . . .	675
Starting a One-Way ETH-DM Session . . . . .	676
Starting a Two-Way ETH-DM Session . . . . .	677
Starting a One-Way ETH-DM Session . . . . .	678
Starting a Two-Way ETH-DM Session . . . . .	678
Managing ETH-DM Statistics and ETH-DM Frame Counts . . . . .	679
Displaying ETH-DM Statistics Only . . . . .	679
Displaying ETH-DM Statistics and Frame Counts . . . . .	679
Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity . . . . .	680
Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level . . . . .	680
Clearing ETH-DM Statistics and Frame Counts . . . . .	681
Displaying ETH-DM Statistics Only . . . . .	681
Displaying ETH-DM Statistics and Frame Counts . . . . .	682
Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity . . . . .	682
Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level . . . . .	683
Clearing ETH-DM Statistics and Frame Counts . . . . .	684
Configuring MEP Interfaces . . . . .	684
Ensuring That Distributed ppm Is Not Disabled . . . . .	685
Enabling the Hardware-Assisted Timestamping Option . . . . .	687
Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling . . . . .	688
Using the monitor ethernet delay-measurement Command . . . . .	689
Managing ETH-LM Statistics . . . . .	690
Displaying ETH-LM Statistics . . . . .	690
Clearing ETH-LM Statistics . . . . .	691
Managing Continuity Measurement Statistics . . . . .	691
Displaying Continuity Measurement Statistics . . . . .	691
Clearing Continuity Measurement Statistics . . . . .	691
Configuring the Failure Notification Protocol . . . . .	692
Ethernet Alarm Indication Signal (ETH-AIS) Function Overview . . . . .	693
Understanding ETH-AIS in a Maintenance Domain . . . . .	693
Fault Detection in a Maintenance Domain . . . . .	693
Terms Defined . . . . .	695
Configuring ETH-AIS on a CFM MEP . . . . .	696
Configuring an Action Profile . . . . .	697
Configuring an Action to Be Taken When an AIS Alarm Is Detected . . . . .	698
Attaching the Action Profile to a CFM MEP . . . . .	699
Example: Configuring One-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces . . . . .	700
Example: Configuring Two-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces . . . . .	705
Example: Configuring Ethernet Frame Delay Measurements with Untagged Interfaces . . . . .	709
Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs . . . . .	711
Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs . . . . .	722
Triggering an Ethernet Frame Delay Measurements Session . . . . .	734

	Viewing Ethernet Frame Delay Measurements Statistics . . . . .	735
<b>Chapter 34</b>	<b>Configuring Ethernet Ring Protection . . . . .</b>	<b>737</b>
	Ethernet Ring Protection . . . . .	737
	Ethernet Ring Protection Using Ring Instances for Load Balancing . . . . .	739
	Example: Configuring Ethernet Ring Protection for MX Series Routers . . . . .	740
	Example Topology . . . . .	740
	Router 1 (RPL Owner) Configuration . . . . .	741
	Router 2 Configuration . . . . .	743
	Router 3 Configuration . . . . .	744
	Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers . . . . .	746
	Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation . . . . .	763
	Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition . . . . .	765
<b>Part 4</b>	<b>Troubleshooting Information</b>	
<b>Chapter 35</b>	<b>Monitoring and Troubleshooting Ethernet Interfaces . . . . .</b>	<b>771</b>
	Configuring Interface Diagnostics Tools to Test the Physical Layer	
	Connections . . . . .	771
	Configuring Loopback Testing . . . . .	771
	Configuring BERT Testing . . . . .	773
	Starting and Stopping a BERT Test . . . . .	776
	Monitoring Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	777
	Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	777
	Monitor Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	778
	Display the Status of Fast Ethernet Interfaces . . . . .	778
	Display the Status of Gigabit Ethernet Interfaces . . . . .	779
	Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface . . . . .	780
	Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface . . . . .	781
	Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface . . . . .	784
	Fiber-Optic Ethernet Interface Specifications . . . . .	785
	Performing Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	786
	Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	786
	Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface . . . . .	787
	Create a Loopback . . . . .	788
	Create a Physical Loopback for a Fiber-Optic Interface . . . . .	788
	Create a Loopback Plug for an RJ-45 Ethernet Interface . . . . .	788
	Configure a Local Loopback . . . . .	789
	Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up . . . . .	790
	Configure a Static Address Resolution Protocol Table Entry . . . . .	793
	Clear Fast Ethernet or Gigabit Ethernet Interface Statistics . . . . .	797
	Ping the Fast Ethernet or Gigabit Ethernet Interface . . . . .	797
	Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics . . . . .	798
	Diagnose a Suspected Circuit Problem . . . . .	800



	Locating the Fast Ethernet and Gigabit Ethernet LINK Alarm and Counters . . .	800
	Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and	
	Counters . . . . .	800
	Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm . . . . .	801
	Fast Ethernet and Gigabit Ethernet Counters . . . . .	802
	Troubleshooting: 10-Gigabit Ethernet Port Stuck in Down State . . . . .	804
<b>Part 5</b>	<b>Configuration Statements and Operational Commands</b>	
<b>Chapter 36</b>	<b>Configuration Statements . . . . .</b>	<b>809</b>
	[edit chassis] Hierarchy Level . . . . .	821
	[edit interfaces] Hierarchy Level . . . . .	822
	[edit interfaces aex aggregated-ether-options load-balance] Hierarchy	
	Level . . . . .	838
	[edit interfaces aex forwarding-options] Hierarchy Level . . . . .	838
	[edit logical-systems] Hierarchy Level . . . . .	839
	[edit protocols authentication-access-control] Configuration Statement	
	Hierarchy on MX Series Routers . . . . .	843
	Supported Statements in the [edit protocols authentication-access-control]	
	Hierarchy Level . . . . .	844
	Unsupported Statements in the [edit protocols	
	authentication-access-control] Hierarchy Level . . . . .	845
	[edit protocols connections] Hierarchy Level . . . . .	845
	[edit protocols dot1x] Hierarchy Level . . . . .	846
	[edit protocols iccp] Hierarchy Level . . . . .	846
	[edit protocols lacp] Hierarchy Level . . . . .	847
	[edit protocols lldp] Hierarchy Level . . . . .	847
	[edit protocols oam] Hierarchy Level . . . . .	847
	[edit protocols ppp] Hierarchy Level . . . . .	850
	[edit protocols pppoe] Hierarchy Level . . . . .	850
	[edit protocols protection-group] Hierarchy Level . . . . .	851
	[edit protocols vrrp] Hierarchy Level . . . . .	851
	[edit security macsec] Configuration Statement Hierarchy on MX Series	
	Routers . . . . .	852
	Supported Statements in the [edit security macsec] Hierarchy Level . . . .	852
	Unsupported Statements in the [edit security macsec] Hierarchy Level . .	853
	[edit system processes] Hierarchy Level . . . . .	853
	802.3ad . . . . .	854
	accept-source-mac . . . . .	855
	access-concentrator . . . . .	856
	account-layer2-overhead (PIC Level) . . . . .	857
	action (OAM) . . . . .	857
	action-profile (Applying to CFM) . . . . .	858
	action-profile (Defining for CFM) . . . . .	859
	action-profile (Defining for LFM) . . . . .	860
	action-profile (MEP) . . . . .	861
	adaptive . . . . .	862
	address . . . . .	863
	adjacency-loss . . . . .	866

advertisement-interval	867
age	868
agent-specifier	869
aggregate (Gigabit Ethernet CoS Policer)	870
aggregated-devices	871
aggregated-ether-options	872
ais-trigger-condition	873
alarm (optics-options)	874
alarms	874
all-defects	875
allow-remote-loopback	875
apply-action-profile	876
arp (Interfaces)	877
asynchronous-notification	878
authentication-access-control (MX Series in Enhanced LAN Mode)	879
authentication-profile-name	880
authenticator	881
auto-discovery	882
auto-negotiation	883
auto-reconnect	884
avg-fd-twoway-threshold	885
avg-ifdv-twoway-threshold	886
avg-flr-forward-threshold	887
avg-flr-backward-threshold	888
backward-frr-enable	889
bandwidth-limit (Policer for Gigabit Ethernet Interfaces)	890
bridge-domain	891
bridge-domains	892
ber-threshold-clear	894
ber-threshold-signal-degrade	896
bfd-liveness-detection (LAG)	899
burst-size-limit (Policer for Gigabit Ethernet Interfaces)	901
bypass	901
bytes (otn-options)	902
cak (MX Series)	902
calculation-weight	903
captive-portal (MX Series in Enhanced LAN Mode)	904
captive-portal-custom-options (MX Series in Enhanced LAN Mode)	905
centralized	907
chassis	908
ckn (MX Series)	908
classifier	909
clear	909
client	910
community-vlans (MX Series)	910
compatibility-version	911
connectivity-association (MACsec Interfaces for MX Series)	911
connectivity-association (MX Series)	912
connectivity-fault-management	914

continuity-check . . . . .	916
control-channel . . . . .	917
convey-loss-threshold . . . . .	917
cross-connect-ccm . . . . .	918
cycle-time . . . . .	918
data-channel . . . . .	919
data-tlv-size . . . . .	920
default-actions . . . . .	921
delay . . . . .	922
delay (PPPoE Service Name Tables) . . . . .	923
delegate-server-processing . . . . .	924
delay-variation . . . . .	924
destination (IPCP) . . . . .	925
detect-loc . . . . .	925
device-count . . . . .	926
direction (MX Series) . . . . .	927
direction . . . . .	928
disable . . . . .	929
disable (Link Protection) . . . . .	929
disable (802.1X for MX Series in Enhanced LAN Mode) . . . . .	930
dot1p-priority . . . . .	930
dot1x . . . . .	931
dot1x (MX Series in Enhanced LAN Mode) . . . . .	932
domain-id . . . . .	933
drop (PPPoE Service Name Tables) . . . . .	933
dynamic-profile (PPPoE Service Name Tables) . . . . .	934
east-interface . . . . .	935
egress-policer-overhead . . . . .	936
encapsulation (Logical Interface) . . . . .	937
encapsulation (Physical Interface) . . . . .	941
encryption (MACsec for MX Series) . . . . .	946
erroneous-ccm . . . . .	947
ether-options . . . . .	948
ethernet (Chassis) . . . . .	949
ethernet (Protocols OAM) . . . . .	950
ethernet-policer-profile . . . . .	953
ethernet-ring . . . . .	954
ethernet-switch-profile . . . . .	955
evcs . . . . .	957
evc-protocol cfm . . . . .	958
event (LFM) . . . . .	959
event-thresholds . . . . .	959
exclude-protocol (MX Series) . . . . .	960
exercise . . . . .	960
failover-delay . . . . .	961
family . . . . .	962
fast-aps-switch . . . . .	966
fastether-options . . . . .	967
fec . . . . .	968

fixed-stuff-bytes	969
flexible-vlan-tagging	970
flow-control	971
fnp	972
force switch	972
force-up	973
forwarding-class (Gigabit Ethernet IQ Classifier)	973
forwarding-mode (100-Gigabit Ethernet)	974
forwarding-mode (PTX Series Packet Transport Routers)	975
frame-error	976
frame-period	977
frame-period-summary	978
framing (10-Gigabit Ethernet Interfaces)	979
gether-options	980
gratuitous-arp-reply	981
guest-vlan (MX Series in Enhanced LAN Mode)	982
guard-interval	983
hardware-assisted-timestamping	984
hardware-assisted-keepalives	985
hold-interval (OAM)	986
hold-interval (Protection Group)	986
hold-multiplier	987
iccp	988
id (MACsec for MX Series)	989
ieee802.1p	989
igmp-snooping	990
ignore-l3-incompletes	991
include-sci (MACsec for MX Series)	992
ingress-policer-overhead	993
ingress-rate-limit	994
inner-tag-protocol-id	995
inner-vlan-id	996
input-policer	997
input-priority-map	998
input-three-color	999
input-vlan-map (Aggregated Ethernet)	1000
input-vlan-map	1001
instance	1002
interface	1003
interface (IEEE 802.1x)	1004
interface (OAM Link-Fault Management)	1005
interface (Static MAC Bypass)	1006
interface-down	1006
interfaces	1007
interfaces (MACsec for MX Series)	1008
interface-none	1009
interface-status-tlv	1009
interval	1010
interval (CFM MEP)	1011

is-ma	1012
isolated-vlan (MX Series)	1013
iteration-count	1014
iteration-period	1014
key (MACsec for MX Series)	1015
key-server-priority (MACsec for MX Series)	1016
lacp (802.3ad)	1017
lacp (Aggregated Ethernet)	1018
laser-enable	1019
layer2-policer	1020
level	1021
level (CFM MEP)	1021
line-loopback	1022
linktrace	1022
link-adjacency-loss	1023
link-discovery	1023
link-down	1024
link-event-rate	1024
link-fault-management	1025
link-mode	1027
link-protection	1028
link-speed (Aggregated Ethernet)	1029
link-speed (Aggregated SONET/SDH)	1031
lldp	1032
lldp-configuration-notification-interval	1033
lmi (Ethernet OAM)	1034
load-balance	1035
load-balance-stateful (Aggregated Ethernet Interfaces)	1036
load-type (Aggregated Ethernet Interfaces)	1037
local-loopback	1038
lockout	1038
log-and-generate-ais	1039
logical-interface-policer	1040
loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet)	1041
loopback (Local and Remote)	1042
loopback-tracking	1042
loss-priority	1043
loss-threshold	1043
lowest-priority-defect	1044
mac	1045
mac (IRB)	1045
mac-address (Accept Source Mac)	1046
mac-address (MACsec)	1047
mac-learn-enable	1048
mac-radius (MX Series in Enhanced LAN Mode)	1049
mac-validate	1050
macsec (MX Series)	1051
maintenance-association	1052
maintenance-domain	1053

major-ring-name	1054
manual switch	1055
master-only	1055
max-sessions (PPPoE Service Name Tables)	1056
max-sessions-vsa-ignore (Static and Dynamic Subscribers)	1057
maximum-links	1058
maximum-requests	1059
maximum-requests (MX Series in Enhanced LAN Mode)	1059
mc-ae	1060
measurement-type	1062
mep	1063
minimum-bandwidth (aggregated Ethernet)	1064
minimum-links	1065
mip-half-function	1066
mixed-rate-mode	1067
mka (MX Series)	1067
monitor-end-point	1068
must-secure (MX Series)	1069
mtu	1070
multicast-router-interface (IGMP Snooping)	1074
multi-chassis-protection	1075
name-format	1076
native-vlan-id	1077
negotiate-address	1078
negotiation-options	1079
no-adaptive	1079
no-allow-link-events	1080
no-encryption (MACsec for MX Series)	1080
no-auto-mdix	1081
no-gratuitous-arp-request	1081
no-keepalives	1082
no-mac-table-binding (802.1X for MX Series in Enhanced LAN Mode)	1082
no-odu-backward-frr-enable	1083
no-odu-signal-degrade-monitor-enable	1083
no-pre-classifier	1084
no-reauthentication (MX Series in Enhanced LAN Mode)	1084
no-send-pads-ac-info	1085
no-send-pads-error	1085
non-revertive (Interfaces)	1086
non-revertive	1086
non-vc-mode	1087
node-id	1087
number-of-frames	1088
offset (MX Series)	1089
oam	1091
oc192	1093
odu-delay-management	1094
odu-backward-frr-enable	1094
odu-signal-degrade	1095

odu-signal-degrade-monitor-enable	1096
odu-ttim-action-enable	1096
optics-options	1097
otn-options	1098
otu-ttim-action-enable	1099
otu4	1100
output-policer	1101
output-priority-map	1102
output-three-color	1103
output-vlan-map (Aggregated Ethernet)	1104
output-vlan-map (Gigabit Ethernet IQ and 10-Gigabit Ethernet with SFPP)	1105
pado-advertise	1106
pass-through	1106
passive-monitor-mode	1107
path-database-size	1108
pdu-interval	1108
pdu-threshold	1109
per-flow (Aggregated Ethernet Interfaces)	1109
peer	1110
performance-monitoring	1111
periodic	1112
policer (CFM Firewall)	1113
policer (CFM Global)	1114
policer (CFM Session)	1115
policer (CoS)	1116
policer (MAC)	1117
pop	1118
pop-pop	1119
pop-swap	1120
port-description-type	1121
port-id (MACsec for MX Series)	1122
port-priority	1123
port-id-subtype	1124
port-status-tlv	1125
pp0 (Dynamic PPPoE)	1126
ppm (Ethernet Switching)	1127
pppoe-options	1128
pppoe-underlying-options (Static and Dynamic Subscribers)	1129
pre-shared-key (MX Series)	1130
premium (Output Priority Map)	1131
premium (Policer)	1131
priority (Protocols OAM)	1132
priority (CFM MEP)	1132
priority (OAM Connectivity-Fault Management)	1133
propagate-tc	1133
protection-group	1134
protocols	1136
protocol (Server MEP)	1137
protocol-down	1137

ptopo-configuration-maximum-hold-time	1138
ptopo-configuration-trap-interval	1138
push	1139
push-push	1140
prbs	1140
preemptive-fast-reroute	1141
premium (Output Priority Map)	1142
premium (Policer)	1142
protect-maintenance-association (OAM)	1143
proxy	1143
proxy-arp	1144
push	1145
push-push	1146
quiet-period	1147
quiet-period (MX Series in Enhanced LAN Mode)	1147
rate	1148
reauthentication	1149
reauthentication (MX Series in Enhanced LAN Mode)	1149
rebalance (Aggregated Ethernet Interfaces)	1150
receive-ais	1150
receive-options-packets	1151
receive-ttl-exceeded	1151
remote	1152
remote-loopback	1152
remote-maintenance-association (OAM)	1153
remote-mep	1153
replay-window-size (MX Series)	1154
replay-protect (MX Series)	1155
restore-interval	1156
retries	1157
retries (MX Series in Enhanced LAN Mode)	1157
revertive	1158
ring-id	1158
ring-protection-link-end	1159
ring-protection-link-owner	1159
routing-instance	1160
routing-instance (PPPoE Service Name Tables)	1161
sa-multicast (100-Gigabit Ethernet)	1162
sa-multicast (PTX Series Packet Transport Routers)	1163
secure-authentication (MX Series in Enhanced LAN Mode)	1164
secure-channel	1165
security-association	1166
send-critical-event	1167
server	1167
server-fail	1168
server-reject-vlan (MX Series in Enhanced LAN Mode)	1169
server-timeout	1170
server-timeout (MX Series in Enhanced LAN Mode)	1170
service (PPPoE)	1171



service-name	1172
service-name-table	1173
service-name-tables	1174
session-expiry (MX Series in Enhanced LAN Mode)	1175
short-name-format	1176
signal-degrade	1177
signal-degrade-monitor-enable	1178
source-address-filter	1180
source-filtering	1181
speed (Ethernet)	1182
speed (MX Series DPC)	1183
sla-iterator-profile	1184
sla-iterator-profiles	1185
stacked-vlan-tagging	1186
static (Protocols 802.1X)	1187
static-interface	1188
start-measurement	1189
supplicant	1189
supplicant (MX Series in Enhanced LAN Mode)	1190
supplicant-timeout	1191
supplicant-timeout (MX Series in Enhanced LAN Mode)	1191
swap	1192
swap-by-poppush	1192
swap-push	1193
swap-swap	1194
switch-options	1194
switch-port	1195
symbol-period	1196
syslog (OAM Action)	1196
system-id	1197
system-priority	1198
tag-protocol-id (TPIDs Expected to Be Sent or Received)	1199
tag-protocol-id (TPID to Rewrite)	1200
tca	1201
terminate (PPPoE Service Name Tables)	1203
traceoptions	1204
traceoptions (Ethernet Ring Protection)	1206
traceoptions (Interface Process)	1208
traceoptions (LACP)	1210
traceoptions (PPPoE)	1212
traceoptions (802.1X and Captive Portal for MX Series in Enhanced LAN Mode)	1215
transmit-delay	1216
transmit-interval (MACsec for MX Series)	1217
transmit-period	1218
transmit-period (MX Series in Enhanced LAN Mode)	1218
transport-monitoring	1219
trigger	1220
tti	1225

tx-power	1226
uac-policy (MX Series in Enhanced LAN Mode)	1226
underlying-interface	1227
unit	1228
unnumbered-address (PPP)	1234
version-3	1235
virtual-control-channel	1236
virtual-switch	1236
vlan-assignment	1237
vlan-id (VLAN ID to Be Bound to a Logical Interface)	1237
vlan-id (VLAN ID to Rewrite)	1238
vlan-id-list (Ethernet VLAN Circuit)	1239
vlan-id-list (Interface in Bridge Domain)	1241
vlan-id-range	1242
vlan-rewrite	1243
vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP)	1244
vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP)	1245
vlan-tagging	1246
vlan-tags	1247
vlan-tags (Dual-Tagged Logical Interface)	1248
vlan-tags (Stacked VLAN Tags)	1250
wait-to-block-interval	1251
warning	1252
wavelength	1253
west-interface	1257
<b>Chapter 37</b>	
<b>Operational Commands</b>	<b>1259</b>
clear interfaces interface-set statistics	1262
clear interfaces interval	1263
clear interfaces aeX forwarding-options load-balance state	1266
clear interfaces aggregate forwarding-options load-balance state	1267
clear interfaces transport pm	1268
clear lldp neighbors	1269
clear lldp statistics	1270
clear oam ethernet connectivity-fault-management	
continuity-measurement	1271
clear oam ethernet connectivity-fault-management linktrace	
path-database	1272
clear oam ethernet connectivity-fault-management loss-statistics	1273
clear oam ethernet connectivity-fault-management policer	1274
clear oam ethernet connectivity-fault-management statistics	1275
clear oam ethernet connectivity-fault-management	
synthetic-loss-measurement	1276
clear oam ethernet link-fault-management state	1277
clear oam ethernet link-fault-management statistics	1278
clear protection-group ethernet-ring statistics	1279
clear security mka statistics (MX Series)	1280
clear security mka statistics (MX Series)	1281
monitor ethernet delay-measurement	1282

monitor ethernet loss-measurement . . . . .	1287
monitor ethernet synthetic-loss-measurement . . . . .	1292
request interface mc-ae switchover (Multichassis Link Aggregation) . . . . .	1296
request interface (revert   switchover) (Aggregated Ethernet Link Protection) . . . . .	1298
request lacp link-switchover . . . . .	1299
show chassis hardware . . . . .	1300
show chassis pic . . . . .	1481
show iccp . . . . .	1498
show interfaces (Adaptive Services) . . . . .	1500
show interfaces (Aggregated Ethernet) . . . . .	1508
show interfaces demux0 (Demux Interfaces) . . . . .	1519
show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port) . . . . .	1528
show interfaces (far-end-interval) . . . . .	1561
show interfaces (Fast Ethernet) . . . . .	1563
show interfaces (Gigabit Ethernet) . . . . .	1579
show interfaces (10-Gigabit Ethernet) . . . . .	1603
show interfaces (M Series, MX Series, T Series Routers, and PTX Series Management and Internal Ethernet) . . . . .	1628
show interfaces (PPPoE) . . . . .	1644
show interfaces interface-set (Ethernet Interface Set) . . . . .	1654
show interfaces interface-set queue . . . . .	1657
show interfaces interval . . . . .	1665
show interfaces irb . . . . .	1669
show interfaces mac-database . . . . .	1675
show interfaces mc-ae . . . . .	1680
show interfaces transport pm . . . . .	1683
show l2-learning instance . . . . .	1689
show l2-learning redundancy-groups . . . . .	1691
show lacp interfaces . . . . .	1695
show lldp . . . . .	1699
show lldp local-information . . . . .	1702
show lldp neighbors . . . . .	1705
show lldp remote-global-statistics . . . . .	1711
show lldp statistics . . . . .	1713
show oam ethernet connectivity-fault-management delay-statistics . . . . .	1716
show oam ethernet connectivity-fault-management forwarding-state . . . . .	1720
show oam ethernet connectivity-fault-management interfaces . . . . .	1724
show oam ethernet connectivity-fault-management linktrace path-database . . . . .	1735
show oam ethernet connectivity-fault-management loss-statistics . . . . .	1738
show oam ethernet connectivity-fault-management mep-database . . . . .	1742
show oam ethernet connectivity-fault-management mep-statistics . . . . .	1753
show oam ethernet connectivity-fault-management path-database . . . . .	1764
show oam ethernet connectivity-fault-management policer . . . . .	1766
show oam ethernet connectivity-fault-management sla-iterator-statistics . . . . .	1769
show oam ethernet connectivity-fault-management synthetic-loss-statistics . . . . .	1774

show oam ethernet evc .....	1777
show oam ethernet fnp interface .....	1778
show oam ethernet fnp messages .....	1779
show oam ethernet fnp status .....	1781
show oam ethernet link-fault-management .....	1783
show oam ethernet lmi .....	1789
show oam ethernet lmi statistics .....	1791
show pppoe interfaces .....	1793
show pppoe service-name-tables .....	1797
show pppoe sessions .....	1800
show pppoe statistics .....	1802
show pppoe underlying-interfaces .....	1804
show pppoe version .....	1810
show protection-group ethernet-ring aps .....	1812
show protection-group ethernet-ring configuration .....	1816
show protection-group ethernet-ring data-channel .....	1822
show protection-group ethernet-ring flush-info .....	1824
show protection-group ethernet-ring interface .....	1826
show protection-group ethernet-ring node-state .....	1829
show protection-group ethernet-ring statistics .....	1833
show protection-group ethernet-ring vlan .....	1837
show security macsec connections (MX Series) .....	1841
show security macsec statistics (MX Series) .....	1843
show security mka sessions (MX Series) .....	1847
show security mka statistics (MX Series) .....	1849
show vrrp .....	1851
traceroute ethernet .....	1863

## Part 6

## Index

Index .....	1869
-------------	------

# List of Figures

<b>Part 1</b>	<b>Ethernet Interfaces</b>	
<b>Chapter 6</b>	<b>Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode</b>	<b>37</b>
	Figure 1: VoIP Multiple Supplicant Topology	45
	Figure 2: VoIP Single Supplicant Topology	46
	Figure 3: Authentication Process Flow for an MX Series Router	59
	Figure 4: Example of a Captive Portal Login Page	63
	Figure 5: Conceptual Model: Dynamic Filter Updated for Each New User	87
	Figure 6: Multiple Supplicants on an 802.1X-Enabled Interface Connecting to a File Server	88
<b>Chapter 8</b>	<b>Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy</b>	<b>121</b>
	Figure 7: Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers	161
	Figure 8: Traffic Polarization on Cascaded Routers When Symmetrical Load Balancing is Enabled on Trio-based MPCs	165
	Figure 9: Aggregated Ethernet Load Balancing	173
	Figure 10: Configuring Independent Micro BFD Session for LAG	192
<b>Chapter 9</b>	<b>Configuring Ethernet Automatic Protection Switching for High Availability</b>	<b>205</b>
	Figure 11: Connections Terminating on Single PE	206
	Figure 12: Connections Terminating on a Different PE	207
	Figure 13: Understanding APS Events	208
	Figure 14: Topology of a Network Using VPWS Psuedowires	209
<b>Chapter 10</b>	<b>Configuring Ethernet Ring Protection Switching for High Availability</b>	<b>213</b>
	Figure 15: Protocol Packets from the Network to the Router	217
	Figure 16: Protocol Packets from the Router or Switch to the Network	217
	Figure 17: Example of a Three-Node Ring Topology	222
<b>Chapter 13</b>	<b>Configuring Private VLANs</b>	<b>265</b>
	Figure 18: Subdomains in a PVLAN With One Router	267
	Figure 19: Configuring a PVLAN on a Single Switch	270
	Figure 20: PVLAN Topology with Secondary VLAN Trunk Ports and Promiscuous Access Port	281
<b>Chapter 14</b>	<b>Configuring Layer 2 Bridging Interfaces</b>	<b>305</b>
	Figure 21: Configuring the MAC Address of an IRB Interface	308
<b>Chapter 17</b>	<b>Configuring Point-to-Point Protocol over Ethernet</b>	<b>327</b>

	Figure 22: PPPoE Session on an Ethernet Loop . . . . .	329
<b>Chapter 18</b>	<b>Configuring Restricted and Unrestricted Proxy ARP . . . . .</b>	<b>343</b>
	Figure 23: Edge Device Case for Unrestricted Proxy ARP . . . . .	344
	Figure 24: Core Device Case for Unrestricted Proxy ARP . . . . .	345
<b>Chapter 20</b>	<b>Configuring TCC and Layer 2.5 Switching . . . . .</b>	<b>351</b>
	Figure 25: Sample Topology of Layer 2.5 Translational Cross-Connect . . . . .	353
<b>Part 2</b>	<b>Gigabit Ethernet Interfaces</b>	
<b>Chapter 21</b>	<b>Configuring 10-Gigabit Ethernet LAN/WAN PICs . . . . .</b>	<b>357</b>
	Figure 26: Control Queue Rate Limiter Scenario . . . . .	367
<b>Chapter 27</b>	<b>Configuring Gigabit Ethernet OTN Options . . . . .</b>	<b>421</b>
	Figure 27: Pre-FEC BER Monitoring . . . . .	432
<b>Chapter 30</b>	<b>Stacking and Rewriting Gigabit Ethernet VLAN Tags . . . . .</b>	<b>483</b>
	Figure 28: swap-push (transparent tag) . . . . .	510
	Figure 29: swap-push (no transparent tag) . . . . .	510
	Figure 30: push (transparent tag) . . . . .	510
	Figure 31: push-push (transparent tag) . . . . .	511
<b>Part 3</b>	<b>Operation, Administration, and Management (OAM) for Ethernet Interfaces</b>	
<b>Chapter 31</b>	<b>Configuring IEEE 802.1ag OAM Connectivity-Fault Management . . . . .</b>	<b>517</b>
	Figure 32: Relationship Among MEPs, MIPs, and Maintenance Domain Levels . .	521
	Figure 33: Relationship Among Bridges, Maintenance Domains, Maintenance Associations, and MEPs . . . . .	521
	Figure 34: Scope of the E-LMI Protocol . . . . .	540
	Figure 35: E-LMI Configuration for a Point-to-Point EVC (SVLAN) Monitored by CFM . . . . .	544
	Figure 36: CET inter-op Dual Homed Topology . . . . .	561
	Figure 37: CET inter-op Dual Attached Topology . . . . .	562
	Figure 38: Topology of CET network . . . . .	564
	Figure 39: Layer 2 VPN Topology . . . . .	566
	Figure 40: Ethernet CFM on Physical Interfaces . . . . .	578
	Figure 41: Ethernet CFM over a Bridge Network . . . . .	580
	Figure 42: Ethernet OAM with VPLS . . . . .	584
<b>Chapter 32</b>	<b>Configuring IEEE 802.3ah OAM Link-Fault Management . . . . .</b>	<b>593</b>
	Figure 43: Ethernet LFM Between Provider Edge and Customer Edge . . . . .	613
	Figure 44: Ethernet LFM for CCC . . . . .	615
	Figure 45: Ethernet LFM for Aggregated Ethernet . . . . .	616
	Figure 46: Ethernet LFM with Loopback Support . . . . .	618
<b>Chapter 33</b>	<b>Configuring ITU-T Y.1731 Ethernet Service OAM . . . . .</b>	<b>621</b>
	Figure 47: Relationship of MEPs, MIPs, and Maintenance Domain Levels . . . . .	624
	Figure 48: VPWS Service Configured Between Two MX Series Routers . . . . .	712
	Figure 49: VPWS Service Configured Between Two MX Series Routers . . . . .	723
<b>Chapter 34</b>	<b>Configuring Ethernet Ring Protection . . . . .</b>	<b>737</b>

---

	Figure 50: Ethernet Ring Protection Example Nodes . . . . .	740
	Figure 51: ERP with Multiple Protection Instances Configured on Three MX Series Routers . . . . .	748
<b>Part 4</b>	<b>Troubleshooting Information</b>	
<b>Chapter 35</b>	<b>Monitoring and Troubleshooting Ethernet Interfaces . . . . .</b>	<b>771</b>
	Figure 52: RJ-45 Ethernet Loopback Plug . . . . .	789





# List of Tables

	<b>About the Documentation</b> . . . . .	<b>xlili</b>
	Table 1: Notice Icons . . . . .	xlvi
	Table 2: Text and Syntax Conventions . . . . .	xlvi
<b>Part 1</b>	<b>Ethernet Interfaces</b>	
<b>Chapter 6</b>	<b>Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode</b> . . . . .	<b>37</b>
	Table 3: Configurable Elements of a Captive Portal Login Page . . . . .	63
	Table 4: Components of the MAC RADIUS Authentication Configuration Topology . . . . .	69
	Table 5: Components of the Topology . . . . .	78
	Table 6: Components of the Topology . . . . .	80
	Table 7: Components of the Static MAC Authentication Configuration Topology . . . . .	84
<b>Chapter 7</b>	<b>Configuring Media Access Control Security (MACsec)</b> . . . . .	<b>91</b>
	Table 8: Components of the MPLS Topology . . . . .	101
	Table 9: MACsec Connectivity Association Summary . . . . .	102
	Table 10: Bridge Domains Summary . . . . .	102
<b>Chapter 8</b>	<b>Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy</b> . . . . .	<b>121</b>
	Table 11: Platform Support Matrix for Mixed Aggregated Ethernet Bundles . . . . .	123
	Table 12: Mixed Rates and Mixed Modes Support on Junos OS . . . . .	130
	Table 13: Platform Support Matrix for Mixed Aggregated Ethernet Bundles . . . . .	131
	Table 14: Untagged Aggregated Ethernet and LACP Support by PIC and Platform . . . . .	147
<b>Chapter 12</b>	<b>Configuring 802.1Q VLANs</b> . . . . .	<b>235</b>
	Table 15: VLAN ID Range by Interface Type . . . . .	237
	Table 16: Configuration Statements Used to Bind VLAN IDs to Logical Interfaces . . . . .	242
	Table 17: Configuration Statements Used to Associate VLAN IDs to VLAN Demux Interfaces . . . . .	246
	Table 18: Encapsulation Inside Circuits CCC-Connected by VLAN-Bundled Logical Interfaces . . . . .	261
<b>Chapter 13</b>	<b>Configuring Private VLANs</b> . . . . .	<b>265</b>
	Table 19: When VLANs in a PVLAN Need 802.1Q Tags . . . . .	268
	Table 20: PVLAN Ports and Layer 2 Connectivity . . . . .	269

	Table 21: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 1 . . . . .	281
	Table 22: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 2 . . . . .	282
<b>Part 2</b>	<b>Gigabit Ethernet Interfaces</b>	
<b>Chapter 21</b>	<b>Configuring 10-Gigabit Ethernet LAN/WAN PICs . . . . .</b>	<b>357</b>
	Table 23: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs . . . . .	360
	Table 24: Handling Oversubscription on 10-Gigabit Ethernet LAN/WAN PICs . .	370
	Table 25: Port Numbering Table . . . . .	373
<b>Chapter 22</b>	<b>Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength . . . . .</b>	<b>381</b>
	Table 26: Wavelength-to-Frequency Conversion Matrix . . . . .	382
<b>Chapter 26</b>	<b>Configuring 100-Gigabit Ethernet PICs/MICs . . . . .</b>	<b>395</b>
	Table 27: MX Series 100-Gigabit Ethernet Interfaces . . . . .	396
	Table 28: PTX Series 100-Gigabit Ethernet Interfaces . . . . .	396
	Table 29: T Series 100-Gigabit Ethernet Interfaces . . . . .	397
	Table 30: Capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP . . . . .	410
	Table 31: Wavelength-to-Frequency Conversion Matrix . . . . .	418
<b>Chapter 27</b>	<b>Configuring Gigabit Ethernet OTN Options . . . . .</b>	<b>421</b>
	Table 32: Example—Signal Degrade and Clear Threshold Values at 1 dBQ . . . .	434
	Table 33: Example—Signal Degrade and Clear Thresholds After Configuration . . . . .	434
	Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers . . . . .	438
<b>Chapter 28</b>	<b>Configuring Gigabit Ethernet Accounting and Policing . . . . .</b>	<b>455</b>
	Table 35: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs . .	456
	Table 36: Adjustment Bytes for Logical Interfaces over Ethernet Interfaces . .	460
	Table 37: Default Forwarding Classes . . . . .	467
<b>Chapter 29</b>	<b>Configuring Gigabit Ethernet Autonegotiation . . . . .</b>	<b>477</b>
	Table 38: Mode and Autonegotiation Status (Local) . . . . .	479
	Table 39: Mode and Autonegotiation Status (Remote) . . . . .	481
<b>Chapter 30</b>	<b>Stacking and Rewriting Gigabit Ethernet VLAN Tags . . . . .</b>	<b>483</b>
	Table 40: Rewrite Operations on Untagged, Single-Tagged, and Dual-Tagged Frames . . . . .	485
	Table 41: Applying Rewrite Operations to VLAN Maps . . . . .	487
	Table 42: Rewrite Operations and Statement Usage for Input VLAN Maps . . . .	491
	Table 43: Rewrite Operations and Statement Usage for Output VLAN Maps . .	492
	Table 44: Input VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations . . . . .	499
	Table 45: Output VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations . . . . .	499
	Table 46: Rules for Applying Rewrite Operations to VLAN Maps . . . . .	499
	Table 47: VLAN Map Operation and IEEE 802.1p Inheritance . . . . .	509

<b>Part 3</b>	<b>Operation, Administration, and Management (OAM) for Ethernet Interfaces</b>	
<b>Chapter 31</b>	<b>Configuring IEEE 802.1ag OAM Connectivity-Fault Management . . . . .</b>	<b>517</b>
	Table 48: Service Protection Options . . . . .	534
	Table 49: Format of TLVs . . . . .	548
	Table 50: Type Field Values for Various TLVs for CFM PDUs . . . . .	549
	Table 51: Port Status TLV Format . . . . .	551
	Table 52: Port Status TLV Values . . . . .	551
	Table 53: Interface Status TLV Format . . . . .	554
	Table 54: Interface Status TLV Values . . . . .	554
	Table 55: Loss Threshold TLV Format . . . . .	570
<b>Chapter 33</b>	<b>Configuring ITU-T Y.1731 Ethernet Service OAM . . . . .</b>	<b>621</b>
	Table 56: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields . . . . .	658
	Table 57: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields . . . . .	660
	Table 58: ETH-DM Statistics . . . . .	668
	Table 59: ETH-DM Frame Counts . . . . .	669
	Table 60: Operational Mode Commands . . . . .	694
	Table 61: AIS Transmission Periodicity . . . . .	696
	Table 62: Monitor Ethernet Delay Command Parameters . . . . .	734
	Table 63: Show Ethernet Delay Command Parameters . . . . .	736
<b>Chapter 34</b>	<b>Configuring Ethernet Ring Protection . . . . .</b>	<b>737</b>
	Table 64: Components of the Network Topology . . . . .	748
<b>Part 4</b>	<b>Troubleshooting Information</b>	
<b>Chapter 35</b>	<b>Monitoring and Troubleshooting Ethernet Interfaces . . . . .</b>	<b>771</b>
	Table 65: Loopback Modes by Interface Type . . . . .	772
	Table 66: BERT Capabilities by Interface Type . . . . .	775
	Table 67: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	777
	Table 68: Status of Fast Ethernet Interfaces . . . . .	778
	Table 69: Status of Gigabit Ethernet Interfaces . . . . .	779
	Table 70: Errors to Look For . . . . .	782
	Table 71: MAC Statistics Errors . . . . .	783
	Table 72: Autonegotiation Information . . . . .	783
	Table 73: Fiber-Optic Ethernet Interface Specifications . . . . .	785
	Table 74: Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces . . . . .	787
	Table 75: Problems and Solutions for a Physical Link That Is Down . . . . .	792
	Table 76: Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters . . . . .	801
	Table 77: Major Fast Ethernet and Gigabit Ethernet Counters . . . . .	803
<b>Part 5</b>	<b>Configuration Statements and Operational Commands</b>	
<b>Chapter 36</b>	<b>Configuration Statements . . . . .</b>	<b>809</b>

## Chapter 37

Table 78: Default Clear Threshold Values . . . . .	894
Table 79: Default Signal Degrade Threshold Values . . . . .	897
<b>Operational Commands . . . . .</b>	<b>1259</b>
Table 80: monitor ethernet delay-measurement one-way Output Fields . . . . .	1284
Table 81: monitor ethernet delay-measurement two-way Output Fields . . . . .	1285
Table 82: monitor ethernet loss-measurement output fields . . . . .	1289
Table 83: monitor ethernet synthetic-loss-measurement Output Fields . . . . .	1294
Table 84: Routing Engines Displaying DIMM Information . . . . .	1303
Table 85: show chassis hardware Output Fields . . . . .	1308
Table 86: show chassis pic Output Fields . . . . .	1485
Table 87: show iccp . . . . .	1498
Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields . . . . .	1500
Table 89: Aggregated Ethernet show interfaces Output Fields . . . . .	1508
Table 90: show interfaces demux0 (Demux Interfaces) Output Fields . . . . .	1519
Table 91: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs . . . . .	1529
Table 92: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics . . . . .	1530
Table 93: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers . . . . .	1533
Table 94: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers . . . . .	1536
Table 95: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers . . . . .	1539
Table 96: show interfaces diagnostics optics Output for Virtual Chassis Ports . . . . .	1541
Table 97: show interfaces far-end-interval Output Fields . . . . .	1561
Table 98: show interfaces Fast Ethernet Output Fields . . . . .	1563
Table 99: show interfaces (Gigabit Ethernet) Output Fields . . . . .	1580
Table 100: Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type . . . . .	1594
Table 101: show interfaces Gigabit Ethernet Output Fields . . . . .	1604
Table 102: Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type . . . . .	1618
Table 103: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface . . . . .	1629
Table 104: show interfaces (PPPoE) Output Fields . . . . .	1644
Table 105: Ethernet show interfaces interface-set Output Fields . . . . .	1654
Table 106: Ethernet show interfaces interface-set queue Output Fields . . . . .	1657
Table 107: show interfaces interval Output Fields . . . . .	1665
Table 108: show interfaces irb Output Fields . . . . .	1669
Table 109: show interfaces mac-database Output Fields . . . . .	1676
Table 110: show interfaces mc-ae Output Fields . . . . .	1680
Table 111: show interfaces transport pm Output Fields . . . . .	1683
Table 112: show l2-learning instance Output Fields . . . . .	1689
Table 113: show l2-learning redundancy-groups arp-statistics Output Fields . . . . .	1692
Table 114: show l2-learning redundancy-groups nd-statistics Output Fields . . . . .	1692

Table 115: show l2-learning redundancy-groups remote-macs Output Fields . .	1693
Table 116: show lacp interfaces Output Fields . . . . .	1695
Table 117: show lldp Output Fields . . . . .	1699
Table 118: show lldp local-information Output Fields . . . . .	1702
Table 119: show lldp neighbors Output Fields . . . . .	1705
Table 120: show lldp remote-global-statistics Output Fields . . . . .	1711
Table 121: show lldp statistics Output Fields . . . . .	1713
Table 122: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields . . . . .	1717
Table 123: show oam ethernet connectivity-fault-management forwarding-state Output Fields . . . . .	1720
Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields . . . . .	1725
Table 125: show oam ethernet connectivity-fault-management linktrace path-database Output Fields . . . . .	1735
Table 126: show oam ethernet connectivity-fault-management loss-statistics Output Fields . . . . .	1738
Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields . . . . .	1743
Table 128: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields . . . . .	1754
Table 129: show oam ethernet connectivity-fault-management path-database Output Fields . . . . .	1764
Table 130: show oam ethernet connectivity-fault-management policer Output Fields . . . . .	1766
Table 131: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields . . . . .	1769
Table 132: show oam ethernet connectivity-fault-management synthetic-loss-statistics Output Fields . . . . .	1775
Table 133: show oam ethernet evc Output Fields . . . . .	1777
Table 134: show oam ethernet fnp interface Output Fields . . . . .	1778
Table 135: show oam ethernet fnp messages Output Fields . . . . .	1779
Table 136: show oam ethernet fnp status Output Fields . . . . .	1781
Table 137: show oam ethernet link-fault-management Output Fields . . . . .	1783
Table 138: show oam ethernet lmi Output Fields . . . . .	1789
Table 139: show oam ethernet lmi statistics Output Fields . . . . .	1791
Table 140: show pppoe interfaces Output Fields . . . . .	1793
Table 141: show pppoe service-name-tables Output Fields . . . . .	1797
Table 142: show pppoe sessions Output Fields . . . . .	1800
Table 143: show pppoe statistics Output Fields . . . . .	1802
Table 144: show pppoe underlying-interfaces Output Fields . . . . .	1804
Table 145: show pppoe version Output Fields . . . . .	1810
Table 146: show protection-group ethernet-ring aps Output Fields . . . . .	1812
Table 147: show protection-group ethernet-ring configuration Output Fields . .	1816
Table 148: show protection-group ethernet-ring data-channel Output Fields . .	1822
Table 149: show protection-group ethernet-ring flush-info Output Fields . . .	1824
Table 150: MX Series Routers show protection-group ethernet-ring interface Output Fields . . . . .	1826
Table 151: show protection-group ethernet-ring node-state Output Fields . . .	1829

Table 152: show protection-group ethernet-ring statistics Output Fields . . . . .	1833
Table 153: show protection-group ethernet-ring statistics detail Output Fields (for MX Series Routers) . . . . .	1835
Table 154: show protection-group ethernet-ring vlan Output Fields . . . . .	1837
Table 155: show security macsec connections Output Fields . . . . .	1841
Table 156: show security macsec statistics Output Fields . . . . .	1843
Table 157: show security mka sessions Output Fields . . . . .	1847
Table 158: show security mka statistics Output Fields . . . . .	1849
Table 159: show vrrp Output Fields . . . . .	1852
Table 160: traceroute ethernet Output Fields . . . . .	1864

# About the Documentation

- [Documentation and Release Notes on page xliii](#)
- [Supported Platforms on page xliii](#)
- [Using the Examples in This Manual on page xliii](#)
- [Documentation Conventions on page xlv](#)
- [Documentation Feedback on page xlvii](#)
- [Requesting Technical Support on page xlvii](#)

## Documentation and Release Notes

---

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

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

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <http://www.juniper.net/books>.

## Supported Platforms

---

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

- [ACX Series](#)
- [M Series](#)
- [MX Series](#)
- [T Series](#)
- [PTX Series](#)

## Using the Examples in This Manual

---

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming

configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

## Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

```
system {
  scripts {
    commit {
      file ex-script.xsl;
    }
  }
}
interfaces {
  fxp0 {
    disable;
    unit 0 {
      family inet {
        address 10.0.0.1/24;
      }
    }
  }
}
```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

```
[edit]
user@host# load merge /var/tmp/ex-script.conf
load complete
```

## Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.



```
commit {
  file ex-script-snippet.xml; }
```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see the *CLI User Guide*.

## Documentation Conventions

Table 1 on page xlv 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 xlv defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
<b>Bold text like this</b>	Represents text that you type.	To enter configuration mode, type the <b>configure</b> command:  user@host> <b>configure</b>
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> <b>show chassis alarms</b>  No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> <li>Introduces or emphasizes important new terms.</li> <li>Identifies guide names.</li> <li>Identifies RFC and Internet draft titles.</li> </ul>	<ul style="list-style-type: none"> <li>A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li><i>Junos OS CLI User Guide</i></li> <li>RFC 1997, <i>BGP Communities Attribute</i></li> </ul>
<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@# <b>set system domain-name</b> <i>domain-name</i>
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> <li>To configure a stub area, include the <b>stub</b> statement at the [edit protocols ospf area area-id] hierarchy level.</li> <li>The console port is labeled <b>CONSOLE</b>.</li> </ul>
< > (angle brackets)	Encloses optional keywords or variables.	<b>stub &lt;default-metric metric&gt;;</b>
(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.	<b>broadcast   multicast</b>  <b>(string1   string2   string3)</b>
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	<b>rsvp { # Required for dynamic MPLS only</b>
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	<b>community name members [ community-ids ]</b>
Indentation and braces ( { } )	Identifies a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	

---

#### GUI Conventions

---

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

Convention	Description	Examples
<b>Bold text like this</b>	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> <li>In the Logical Interfaces box, select <b>All Interfaces</b>.</li> <li>To cancel the configuration, click <b>Cancel</b>.</li> </ul>
<b>&gt;</b> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select <b>Protocols&gt;Ospf</b> .

## 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](mailto: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

# Ethernet Interfaces

- [Ethernet Interfaces Overview on page 3](#)
- [Performing Initial Configuration for Ethernet Interfaces on page 5](#)
- [Configuring the Management Ethernet Interface on page 25](#)
- [Enabling Passive Monitoring on Ethernet Interfaces on page 29](#)
- [Configuring IEEE 802.1x Port-Based Network Access Control on page 33](#)
- [Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode on page 37](#)
- [Configuring Media Access Control Security \(MACsec\) on page 91](#)
- [Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy on page 121](#)
- [Configuring Ethernet Automatic Protection Switching for High Availability on page 205](#)
- [Configuring Ethernet Ring Protection Switching for High Availability on page 213](#)
- [Configuring MAC Address Validation on Static Ethernet Interfaces on page 231](#)
- [Configuring 802.1Q VLANs on page 235](#)
- [Configuring Private VLANs on page 265](#)
- [Configuring Layer 2 Bridging Interfaces on page 305](#)
- [Configuring Link Layer Discovery Protocol on page 315](#)
- [Configuring VRRP and VRRP for IPv6 on page 323](#)
- [Configuring Point-to-Point Protocol over Ethernet on page 327](#)
- [Configuring Restricted and Unrestricted Proxy ARP on page 343](#)
- [Configuring Static ARP Table Entries on page 347](#)
- [Configuring TCC and Layer 2.5 Switching on page 351](#)



## CHAPTER 1

# Ethernet Interfaces Overview

- [Ethernet Interfaces Overview on page 3](#)
- [MX Series Router Interface Identifiers on page 4](#)

## Ethernet Interfaces Overview

---

Ethernet was developed in the early 1970s at the Xerox Palo Alto Research Center (PARC) as a data-link control layer protocol for interconnecting computers. It was first widely used at 10 megabits per second (Mbps) over coaxial cables and later over unshielded twisted pairs using 10Base-T. More recently, 100Base-TX (Fast Ethernet, 100 Mbps), Gigabit Ethernet (1 gigabit per second [Gbps]), 10-Gigabit Ethernet (10 Gbps), and 100-Gigabit Ethernet (100 Gbps) have become available.

Juniper Networks routers support the following types of Ethernet interfaces:

- Fast Ethernet
- Tri-Rate Ethernet copper
- Gigabit Ethernet
- Gigabit Ethernet intelligent queuing (IQ)
- Gigabit Ethernet IQ2 and IQ2-E
- 10-Gigabit Ethernet IQ2 and IQ2-E
- 10-Gigabit Ethernet
- 10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM)
- 100-Gigabit Ethernet
- Management Ethernet interface, which is an out-of-band management interface within the router
- Internal Ethernet interface, which connects the Routing Engine to the packet forwarding components
- Aggregated Ethernet interface, a logical linkage of Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet physical connections

**Related Documentation**

- [Configuring Ethernet Physical Interface Properties on page 6](#)
- [MX Series Router Interface Identifiers on page 4](#)
- [Configuring MAC Address Filtering for Ethernet Interfaces on page 13](#)
- [Configuring Ethernet Loopback Capability on page 17](#)
- [Configuring Flow Control on page 11](#)
- [Ignoring Layer 3 Incomplete Errors on page 18](#)
- [Configuring the Link Characteristics on Ethernet Interfaces on page 12](#)
- [Configuring Gratuitous ARP on page 18](#)
- [Adjusting the ARP Aging Timer on page 19](#)
- [Configuring the Interface Speed on Ethernet Interfaces on page 8](#)
- [Configuring the Ingress Rate Limit on page 9](#)
- [Configuring Multicast Statistics Collection on Ethernet Interfaces on page 20](#)
- [Configuring Weighted Random Early Detection on page 20](#)
- [\*Ethernet Interfaces Feature Guide for Routing Devices\*](#)
- [\*Junos OS Network Interfaces Library for Routing Devices\*](#)

---

## MX Series Router Interface Identifiers

Juniper Networks MX Series 3D Universal Edge Routers support several types of line cards, including Dense Port Concentrators (DPCs), Flexible Port Concentrators (FPCs) with associated Physical Interface Cards (PICs), Modular Port Concentrators (MPCs) with associated Modular Interface Cards (MICs), or MICs. FPCs are populated with PICs for various interface types. DPCs and MPCs with associated MICs, and MICs support a variety of port configurations and combine the functions of FPCs and the PICs. The configuration syntax for each type of line card is the same: *type-fpc/pic/port*.

Ports are numbered from 0 through 9 for Gigabit Ethernet and Tri-Rate Ethernet copper interfaces. Port numbers are always 0 for 10-Gigabit Ethernet interfaces.



**NOTE:** In certain displays, the MX Series routers identify the Packet Forwarding Engine (PFE) rather than the PIC number. PFE 0 corresponds to PIC 0, PFE 1 corresponds to PIC 2, PFE 2 corresponds to PIC 1, and PFE 3 corresponds to PIC 3.

**Related Documentation**

- [Ethernet Interfaces Overview on page 3](#)
- [\*Ethernet Interfaces Feature Guide for Routing Devices\*](#)
- [\*Junos OS Network Interfaces Library for Routing Devices\*](#)



## CHAPTER 2

# Performing Initial Configuration for Ethernet Interfaces

- [Example: Configuring Fast Ethernet Interfaces on page 5](#)
- [Example: Configuring Gigabit Ethernet Interfaces on page 6](#)
- [Configuring Ethernet Physical Interface Properties on page 6](#)
- [Configuring the Interface Speed on Ethernet Interfaces on page 8](#)
- [Configuring the Ingress Rate Limit on page 9](#)
- [Understanding Flow Control on page 10](#)
- [Configuring Flow Control on page 11](#)
- [Configuring the Link Characteristics on Ethernet Interfaces on page 12](#)
- [Configuring MAC Address Filtering for Ethernet Interfaces on page 13](#)
- [Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15](#)
- [MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview on page 16](#)
- [Configuring Ethernet Loopback Capability on page 17](#)
- [Ignoring Layer 3 Incomplete Errors on page 18](#)
- [Configuring Gratuitous ARP on page 18](#)
- [Adjusting the ARP Aging Timer on page 19](#)
- [Configuring Weighted Random Early Detection on page 20](#)
- [Configuring Multicast Statistics Collection on Ethernet Interfaces on page 20](#)
- [Displaying Internal Ethernet Interfaces for a Routing Matrix with a TX Matrix Plus Router on page 21](#)

### Example: Configuring Fast Ethernet Interfaces

---

The following configuration is sufficient to get a Fast Ethernet interface up and running. By default, IPv4 Fast Ethernet interfaces use Ethernet version 2 encapsulation.

```
[edit]
user@host# set interfaces fe-5/2/1 unit 0 family inet address local-address
user@host# show
interfaces {
```

```
fe-5/2/1 {
  unit 0 {
    family inet {
      address local-address;
    }
  }
}
```

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Example: Configuring Gigabit Ethernet Interfaces

The following configuration is sufficient to get a Gigabit Ethernet, Tri-Rate Ethernet copper, or 10-Gigabit Ethernet interface up and running. By default, IPv4 Gigabit Ethernet interfaces on MX Series, M Series, and T Series routers use 802.3 encapsulation.

```
[edit]
user@host# set interfaces ge-2/0/1 unit 0 family inet address local-address
user@host# show
interfaces {
  ge-2/0/1 {
    unit 0 {
      family inet {
        address local-address;
      }
    }
  }
}
```

The M160, M320, M120, T320, and T640 2-port Gigabit Ethernet PIC supports two independent Gigabit Ethernet links.

Each of the two interfaces on the PIC is named:

**`ge-fpc/pic/[0.1]`**

Each of these interfaces has functionality identical to the Gigabit Ethernet interface supported on the single-port PIC.

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Ethernet Physical Interface Properties

1. To configure Fast Ethernet-specific physical interface properties, include the **fastether-options** statement at the **[edit interfaces fe-fpc/pic/port]** hierarchy level:

```
[edit interfaces fe-fpc/pic/port]
user@host# set fastether-options;
```



**NOTE:** The speed statement applies to the management Ethernet interface (fxp0 or em0), the Fast Ethernet 12-port and 48-port Physical Interface Card (PIC) interfaces and the MX Series Tri-Rate Ethernet copper interfaces. The Fast Ethernet, fxp0, and em0 interfaces can be configured for 10 Mbps or 100 Mbps (10m | 100m). The MX Series Tri-Rate Ethernet copper interfaces can be configured for 10 Mbps, 100 Mbps, or 1 Gbps (10m | 100m | 1g). The 4-port and 8-port Fast Ethernet PICs support a speed of 100 Mbps only.

MX Series routers support Gigabit Ethernet automatic line sensing of MDI (Media Dependent Interface) and MDIX (Media Dependent Interface with Crossover) port connections. MDI is the Ethernet port connection typically used on network interface cards (NIC). MDIX is the standard Ethernet port wiring for hubs and switches. This feature allows MX Series routers to automatically detect MDI and MDIX connections and configure the router port accordingly. You can disable this feature by using the `no-auto-mdix` statement at the `[edit interfaces ge-fpc/pic/port]` hierarchy level.



**NOTE:** Junos OS supports Ethernet host addresses with no subnets. This enables you to configure an Ethernet interface as a host address (that is, with a network mask of /32), without requiring a subnet. Such interfaces can serve as OSPF point-to-point interfaces, and MPLS is also supported.

2. To configure physical interface properties specific to Gigabit Ethernet and 10-Gigabit Ethernet, include the `gigether-options` statement at the `[edit interfaces ge-fpc/pic/port]` or `[edit interfaces xe-fpc/pic/port]` hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
user@host# set gigether-options ;
```

3. For 10-Gigabit Ethernet DWDM-specific physical interface properties, include the `optics-options` statement at the `[edit interfaces ge-fpc/pic/port]` hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
user@ host# set optics-options;
```

To configure Gigabit Ethernet IQ-specific physical interface properties, include the `gigether-options` statement at the `[edit interfaces ge-fpc/pic/port]` hierarchy level. These statements are supported on 10-Gigabit Ethernet IQ2 and IQ2-E PIC. Some of these statements are also supported on Gigabit Ethernet PICs with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router).

```
[edit interfaces ge-fpc/pic/port]
user@host# set gigether-options {
```

4. To configure 10-Gigabit Ethernet physical interface properties, include the `lan-phy` or `wan-phy` statement at the `[edit interfaces xe-fpc/pic/port framing]` hierarchy level.

```
[edit interfaces interface-name]
```

```
user@host# set framing;
```

5. To configure OAM 802.3ah support for Ethernet interfaces, include the **oam** statement at the **[edit protocols]** hierarchy level.

```
[edit protocols]
user@host# set oam;
```

6. To configure Gigabit Ethernet IQ-specific logical interface properties, include the **input-vlan-map**, **output-vlan-map**, **layer2-policer**, and **vlan-tags** statements at the **[edit interfaces interface-name unit logical-unit-number]** hierarchy level or **[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]**.

```
[edit interfaces interface-name unit logical-unit-number]
user#host# set input-vlan-map;
user@host# set output-vlan-map;
user#host# set layer2-policer{
user@host# set vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
```

7. To configure aggregated Ethernet-specific physical interface properties, include the **aggregated-ether-options** statement at the **[edit interfaces aex]** hierarchy level:

```
[edit interfaces aex]
user@host# set aggregated-ether-options;
```

#### Related Documentation

- [10-Gigabit Ethernet Framing Overview on page 385](#)
- [Example: Configuring Gigabit Ethernet Interfaces on page 6](#)
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the Interface Speed on Ethernet Interfaces

For M Series and T Series Fast Ethernet 12-port and 48-port PIC interfaces, the management Ethernet interface (**fxp0** or **em0**), and the MX Series Tri-Rate Ethernet copper interfaces, you can explicitly set the interface speed. The Fast Ethernet, **fxp0**, and **em0** interfaces can be configured for 10 Mbps or 100 Mbps (**10m** | **100m**). The MX Series Tri-Rate Ethernet copper interfaces can be configured for 10 Mbps, 100 Mbps, or 1 Gbps (**10m** | **100m** | **1g**). For information about management Ethernet interfaces and to determine the management Ethernet interface type for your router, see *Understanding Management Ethernet Interfaces and Supported Routing Engines by RouterMX Series routers*, with MX-DPC and Tri-Rate Copper SFPs, support 20x1 Copper to provide backwards compatibility with 100/10BASE-T and 1000BASE-T operation through an Serial Gigabit Media Independent Interface (SGMII) interface.

1. In configuration mode, go to the **[edit interfaces interface-name]** hierarchy level.

```
[edit ]
user@host# edit interfaces interface-name
```

2. To configure the speed, include the **speed** statement at the **[edit interfaces interface-name]** hierarchy level.

```
[edit interfaces interface-name]
```

```
user@host# set speed (10m | 100m | 1g);
```

**NOTE:**

- By default, the M Series and T Series routers management Ethernet interface autonegotiates whether to operate at 10 megabits per second (Mbps) or 100 Mbps. All other interfaces automatically choose the correct speed based on the PIC type and whether the PIC is configured to operate in multiplexed mode (using the `no-concatenate` statement in the `[edit chassis]` configuration hierarchy.
- When you manually configure Fast Ethernet interfaces on the M Series and T Series routers, link mode and speed must both be configured. If both these values are not configured, the router uses autonegotiation for the link and ignores the user-configured settings.
- If the link partner does not support autonegotiation, configure either Fast Ethernet port manually to match its link partner's speed and link mode. When the link mode is configured, autonegotiation is disabled.
- On MX Series routers with tri-rate copper SFP interfaces, if the port speed is negotiated to the configured value and the negotiated speed and interface speed do not match, the link will not be brought up.
- When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled.
- Half-duplex mode is not supported on Tri-Rate Ethernet copper interfaces. When you include the `speed` statement, you must include the `link-mode full-duplex` statement at the same hierarchy level.

**Related Documentation**

- [speed on page 1182](#)
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the Ingress Rate Limit

On Fast Ethernet 8-port, 12-port, and 48-port PIC interfaces only, you can apply port-based rate limiting to the ingress traffic that arrives at the PIC.

To configure an ingress rate limit on a Fast Ethernet 8-port, 12-port, or 48-port PIC interface, include the `ingress-rate-limit` statement at the `[edit interfaces interface-name fastether-options]` hierarchy level:

```
[edit interfaces interface-name fastether-options]
  ingress-rate-limit rate;
```

*rate* can range in value from 1 through 100 Mbps.

- Related Documentation**
- [ingress-rate-limit on page 994](#)
  - [Ethernet Interfaces Overview on page 3](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Understanding Flow Control

---

Flow control supports lossless transmission by regulating traffic flows to avoid dropping frames during periods of congestion. Flow control stops and resumes the transmission of network traffic between two connected peer nodes on a full-duplex Ethernet physical link. Controlling the flow by pausing and restarting it prevents buffers on the nodes from overflowing and dropping frames. You configure flow control on a per-interface basis.

By default, all forms of flow control are disabled. You must explicitly enable flow control on interfaces to pause traffic.

The MX, T, and PTX Series routers support IEEE 802.3X Ethernet PAUSE method of flow control.

- [IEEE 802.3X Ethernet PAUSE on page 10](#)

### IEEE 802.3X Ethernet PAUSE

Ethernet PAUSE is a congestion relief feature that works by providing link-level flow control for all traffic on a full-duplex Ethernet link. Ethernet PAUSE works in both directions on the link. In one direction, an interface generates and sends Ethernet PAUSE messages to stop the connected peer from sending more traffic. In the other direction, the interface responds to Ethernet PAUSE messages it receives from the connected peer to stop sending traffic. Ethernet PAUSE also works on aggregated Ethernet interfaces. For example, if the connected peer interfaces are called Node A and Node B:

- When the receive buffers on interface Node A reach a certain level of fullness, the interface generates and sends an Ethernet PAUSE message to the connected peer (interface Node B) to tell the peer to stop sending frames. The Node B buffers store frames until the time period specified in the Ethernet PAUSE frame elapses; then Node B resumes sending frames to Node A.
- When interface Node A receives an Ethernet PAUSE message from interface Node B, interface Node A stops transmitting frames until the time period specified in the Ethernet PAUSE frame elapses; then Node A resumes transmission. (The Node A transmit buffers store frames until Node A resumes sending frames to Node B.)

In this scenario, if Node B sends an Ethernet PAUSE frame with a time value of 0 to Node A, the 0 time value indicates to Node A that it can resume transmission. This happens when the Node B buffer empties to below a certain threshold and the buffer can once again accept traffic.

### Symmetric Flow Control

---

Symmetric flow control configures both the receive and transmit buffers in the same state. The interface can both send Ethernet PAUSE messages and respond to them (flow

control is enabled), or the interface cannot send Ethernet PAUSE messages or respond to them (flow control is disabled).

You configure symmetric flow control by including the **flow-control** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level.

When you enable symmetric flow control on an interface, the Ethernet PAUSE behavior depends on the configuration of the connected peer. With symmetric flow control enabled, the interface can perform any Ethernet PAUSE functions that the connected peer can perform. (When symmetric flow control is disabled, the interface does not send or respond to Ethernet PAUSE messages.)

- Related Documentation**
- [flow-control on page 971](#)
  - [Configuring Flow Control on page 11](#)

## Configuring Flow Control

By default, the router or switch imposes flow control to regulate the amount of traffic sent out on a Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interface. Flow control is not supported on the 4-port Fast Ethernet PIC. This is useful if the remote side of the connection is a Fast Ethernet or Gigabit Ethernet switch.

You can disable flow control if you want the router or switch to permit unrestricted traffic. To disable flow control, include the **no-flow-control** statement:

```
no-flow-control;
```

To explicitly reinstate flow control, include the **flow-control** statement:

```
flow-control;
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces *interface-name* aggregated-ether-options]**
- **[edit interfaces *interface-name* ether-options]**
- **[edit interfaces *interface-name* fastether-options]**
- **[edit interfaces *interface-name* gigether-options]**



**NOTE:** On the Type 5 FPC, to prioritize control packets in case of ingress oversubscription, you must ensure that the neighboring peers support MAC flow control. If the peers do not support MAC flow control, then you must disable flow control.

- Related Documentation**
- [flow-control on page 971](#)
  - [Ethernet Interfaces Overview on page 3](#)
  - [EX Series Switches Interfaces Overview](#)

- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the Link Characteristics on Ethernet Interfaces

---

*Full-duplex* communication means that both ends of the communication can send and receive signals at the same time. *Half-duplex* is also bidirectional communication, but signals can flow in only one direction at a time.

By default, the router's management Ethernet interface, **fxp0** or **em0**, autonegotiates whether to operate in full-duplex or half-duplex mode. Fast Ethernet interfaces, can operate in either full-duplex or half-duplex mode, and all other interfaces can operate only in full-duplex mode. For Gigabit Ethernet and 10-Gigabit Ethernet, the link partner must also be set to full duplex.



**NOTE:** For M Series, MX Series, and most T Series routers, the management Ethernet interface is **fxp0**. For T1600 and T4000 routers configured in a routing matrix, and TX Matrix Plus routers, the management Ethernet interface is **em0**.



**NOTE:** Automated scripts that you have developed for standalone T1600 routers (T1600 routers that are not in a routing matrix) might contain references to the **fxp0** management Ethernet interface. Before reusing the scripts on T1600 routers in a routing matrix, edit the command lines that reference the **fxp0** management Ethernet interface so that the commands reference the **em0** management Ethernet interface instead.



**NOTE:** When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled.



**NOTE:** When you manually configure Fast Ethernet interfaces on the M Series and T Series routers, link mode and speed must both be configured. If both these values are not configured, the router uses autonegotiation for the link and ignores the user-configured settings.



**NOTE:** Member links of an aggregated Ethernet bundle must not be explicitly configured with a link mode. You must remove any such link-mode configuration before committing the aggregated Ethernet configuration.



To explicitly configure an Ethernet interface to operate in either full-duplex or half-duplex mode, include the **link-mode** statement at the **[edit interfaces *interface-name*]** hierarchy level:

```
[edit interfaces interface-name]  
link-mode (full-duplex | half-duplex);
```

**Related  
Documentation**

- [link-mode on page 1027](#)
- [Ethernet Interfaces Overview on page 3](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring MAC Address Filtering for Ethernet Interfaces

- [Enabling Source Address Filtering on page 13](#)

### Enabling Source Address Filtering

On aggregated Ethernet interfaces, Fast Ethernet, Gigabit Ethernet, Gigabit Ethernet IQ, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), you can enable source address filtering to block all incoming packets from a specific MAC address.

To enable the filtering, include the **source-filtering** statement at the following hierarchy levels:

- **[edit interfaces *interface-name* aggregated-ether-options]**
- **[edit interfaces *interface-name* fastether-options]**
- **[edit interfaces *interface-name* gigether-options]**



**NOTE:** When you integrate a standalone T640 router into a routing matrix, the PIC media access control (MAC) addresses for the integrated T640 router are derived from a pool of MAC addresses maintained by the TX Matrix router. For each MAC address you specify in the configuration of a formerly standalone T640 router, you must specify the same MAC address in the configuration of the TX Matrix router.

Similarly, when you integrate a T1600 or T4000 router into a routing matrix, the PIC MAC addresses for the integrated T1600 or T4000 router are derived from a pool of MAC addresses maintained by the TX Matrix Plus router. For each MAC address you specify in the configuration of a formerly standalone T1600 or T4000 router, you must specify the same MAC address in the configuration of the TX Matrix Plus router.

When source address filtering is enabled, you can configure the interface to receive packets from specific MAC addresses. To do this, specify the MAC addresses in the **source-address-filter *mac-address*** statement at the following hierarchy levels:

- [edit interfaces *interface-name* aggregated-ether-options]
- [edit interfaces *interface-name* fastether-options]
- [edit interfaces *interface-name* gigether-options]

You can specify the MAC address as *nn:nn:nn:nn:nn:nn* or *nnnn.nnnn.nnnn*, where *n* is a hexadecimal number. You can configure up to 64 source addresses. To specify more than one address, include the **source-address-filter** statement multiple times.



**NOTE:** The **source-address-filter** statement is not supported on Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router); instead, include the **accept-source-mac** statement. For more information, see [“Configuring Gigabit Ethernet Policers” on page 465](#).

If the remote Ethernet card is changed, the interface cannot receive packets from the new card because it has a different MAC address.

Source address filtering does not work when Link Aggregation Control Protocol (LACP) is enabled. This behavior is not applicable to T series routers and PTX Series Packet Transport Routers. For more information about LACP, see [“Configuring LACP for Aggregated Ethernet Interfaces” on page 148](#).



**NOTE:** On untagged Gigabit Ethernet interfaces, you should not configure the **source-address-filter** statement at the [edit interfaces *ge-fpc/pic/port* gigether-options] hierarchy level and the **accept-source-mac** statement at the [edit interfaces *ge-fpc/pic/port* gigether-options unit *logical-unit-number*] hierarchy level simultaneously. If these statements are configured for the same interfaces at the same time, an error message is displayed.

On tagged Gigabit Ethernet interfaces, you should not configure the **source-address-filter** statement at the [edit interfaces [edit interfaces *ge-fpc/pic/port* gigether-options] hierarchy level and the **accept-source-mac** statement at the [edit interfaces *ge-fpc/pic/port* gigether-options unit *logical-unit-number*] hierarchy level with an identical MAC address specified in both filters. If these statements are configured for the same interfaces with an identical MAC address specified, an error message is displayed.



**NOTE:** The **source-address-filter** statement is not supported on MX Series routers with MPC4E (model numbers: MPC4E-3D-32XGE-SFPP and MPC4E-3D-2CGE-8XGE); instead, include the **accept-source-mac** statement. For more information, see [“Configuring Gigabit Ethernet Policers” on page 465](#).

Related Documentation

- [source-address-filter on page 1180](#)

- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring LACP for Aggregated Ethernet Interfaces on page 148](#)
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring MAC Address Filtering on PTX Series Packet Transport Routers

---

This topic describes how to configure MAC filtering on PTX Series Packet Transport Routers. MAC filtering enables you to specify the MAC addresses from which the Ethernet interface can receive packets.

MAC filtering support on PTX Series Packet Transport Routers includes:

- MAC source and destination address filtering for each port.
- MAC source address filtering for each physical interface.
- MAC source address filtering for each logical interface.

When you filter logical and physical interfaces, you can specify up to 1000 MAC source addresses per port.

To configure MAC source address filtering for a physical interface, include the **source-filtering** and **source-address-filter** statements at the **[edit interfaces et-fpc/pic/port gigether-options]** hierarchy level:

```
[edit interfaces]
et-x/y/z {
  gigether-options {
    source-filtering;
    source-address-filter {
      mac-address;
    }
  }
}
```

The **source-address-filter** statement configures which MAC source addresses are filtered. The specified physical interface drops all packets from the MAC source addresses you specify. You can specify the MAC address as **nn:nn:nn:nn:nn:nn** where **n** is a decimal digit. To specify more than one address, include multiple **mac-address** options in the **source-address-filter** statement.

To configure MAC source address filtering for a logical interface, include the **accept-source-mac** statement at the **[edit interfaces et-fpc/pic/port unit logical-unit-number]** hierarchy level:

```
[edit interfaces]
et-x/y/z {
  gigether-options {
    source-filtering;
  }
  unit logical-unit-number {
```

```
accept-source-mac {  
    mac-address mac-address;  
}  
}
```

The **accept-source-mac** statement configures which MAC source addresses are accepted on the logical interface. You can specify the MAC address as **nn:nn:nn:nn:nn:nn** where **n** is a decimal digit. To specify more than one address, include multiple **mac-address mac-address** options in the **accept-source-mac** statement.

After an interface filter is configured, there is an accounting entry that is associated with the MAC address filter. Counters accumulate if there are packets with matching MAC source addresses. You can use the **show interfaces mac-database** Junos OS CLI command to view the address count.

Related Documentation

- [show interfaces mac-database on page 1675](#)

---

## MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview

---

Apart from the capability to compute MAC address statistics for dynamically learned static and destination MAC addresses on physical interfaces, starting in Junos OS Release 15.1, Junos OS enables you to configure source MAC (SMAC) address and destination MAC (DMAC) address-based accounting for MAC addresses that are dynamically learned on aggregated Ethernet (ae-) interfaces in routed mode. When you include the **mac-learn-enable** statement at the **[edit interfaces aex aggregated-ether-options ethernet-switch-profile]** hierarchy level, dynamic learning of source and destination MAC addresses is enabled. By default, this capability is disabled. When dynamic learning of MAC addresses is enabled for AE interfaces in routed mode, the MAC-filter settings are updated for each of the child links of the AE bundle interface. This feature provides for both the configuration of the **mac-learn-enable** filter and the display of SMAC and DMAC based accounting information on the aggregated interface in the output of the **show interfaces mac-database interface-name mac-address mac-address** command.

When this functionality is enabled, source and destination MAC addresses-based accounting is supported on the routed interfaces on MX Series routers with DPCs and MPCs. Support for mixed mode LAG interfaces is also available. This feature supports MAC address accounting for AE interfaces in routed mode (for inet family). Destination MAC-based accounting is supported only for MAC addresses dynamically learned at the ingress interface, including each individual child or member link of the AE bundle. This behavior occurs because MPCs do not support destination MAC address learning. As a result, if a packet exits a child link without passing in the ingress direction through that link, destination MAC (DMAC) accounting for this packet occurs at the child link level and this data is not available at the aggregate level. Dynamic learning of MAC addresses can be supported on only the AE interface or on selective individual member links. MAC learning support on the bundle depends on the capability of individual member links. If a link in the bundle does not contain the capability to support MAC learning or accounting, it is disabled on the AE bundle.

The MAC data for the aggregated bundle is displayed by collecting data from individual child links. This data is collected when the command to display the MAC database is triggered from the CLI. This method of data collection implies that based on the number of child links and the size of the MAC database, the time taken to display the database differs. This approach to obtain the current snapshot of the MAC database from the currently active child links is used instead of maintaining a database at the Routing Engine because of the dynamic nature of the MAC database and the overhead required to maintain the database information in synchronization with all the child Packet Forwarding Engines. A difference in the DMAC-based accounting for packets generated from the Routing Engine (packets sent in the host path). On DPCs, these packets are accounted in egress direction (Output Packet/Byte count), whereas on MPCs, these packets are not accounted because DMAC learning is not supported. This difference in behavior also occurs between child links on DPCs and MPCs. Because this feature to enable dynamic learning is related to collecting MAC database statistics from child links based on the command issued from the CLI, there is an impact on the time it takes to display the data on the console based on the size of the MAC database and the number of child-links spread across different FPCs. The limit on the maximum number of MAC addresses that can be learned from an interface does not apply to this dynamic learning of MAC addresses functionality.

Related Documentation • [mac-learn-enable on page 1048](#)

## Configuring Ethernet Loopback Capability

By default, local aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces connect to a remote system. To place an interface in loopback mode, include the **loopback** statement:

```
loopback;
```



**NOTE:** If you configure a local loopback on a 1-port 10-Gigabit IQ2 and IQ2-E PIC using the **loopback** statement at the [edit interfaces *interface-name* *gigether-options*] hierarchy level, the transmit-path stops working, causing the remote end to detect a link down.

To return to the default—that is, to disable loopback mode—delete the **loopback** statement from the configuration:

```
[edit]
user@host# delete interfaces fe-fpc/port fastether-options loopback
```

To explicitly disable loopback mode, include the **no-loopback** statement:

```
no-loopback;
```

You can include the **loopback** and **no-loopback** statements at the following hierarchy levels:

- [edit interfaces *interface-name* aggregated-ether-options]
- [edit interfaces *interface-name* ether-options]
- [edit interfaces *interface-name* fastether-options]
- [edit interfaces *interface-name* gigheter-options]

**Related  
Documentation**

- [loopback on page 1041](#)
- [Ethernet Interfaces Overview on page 3](#)
- *EX Series Switches Interfaces Overview*
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Ignoring Layer 3 Incomplete Errors

By default, Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces count Layer 3 incomplete errors. You can configure the interface to ignore Layer 3 incomplete errors.

To ignore Layer 3 incomplete errors, include the **ignore-l3-incompletes** statement:

**ignore-l3-incompletes;**

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* fastether-options]
- [edit interfaces *interface-name* gigheter-options]

**Related  
Documentation**

- [ignore-l3-incompletes on page 991](#)
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Gratuitous ARP

Gratuitous Address Resolution Protocol (ARP) requests help detect duplicate IP addresses. A gratuitous ARP is a broadcast request for a router's own IP address. If a router or switch sends an ARP request for its own IP address and no ARP replies are received, the router- or switch-assigned IP address is not being used by other nodes. However, if a router or switch sends an ARP request for its own IP address and an ARP reply is received, the router- or switch-assigned IP address is already being used by another node.

Gratuitous ARP replies are reply packets sent to the broadcast MAC address with the target IP address set to be the same as the sender's IP address. When the router or switch

receives a gratuitous ARP reply, the router or switch can insert an entry for that reply in the ARP cache. By default, updating the ARP cache on gratuitous ARP replies is disabled on the router or switch.

To enable updating of the ARP cache for gratuitous ARPs:

1. In configuration mode, go to the **[edit interfaces interface-name]** hierarchy level.

```
[edit]
user@host# edit interfaces interface-name
```

2. Include the **gratuitous-arp-reply** statement.

```
[edit interfaces interface-name]
user@host# set gratuitous-arp-reply
```

To restore the default behavior, that is, to disable updating of the ARP cache for gratuitous ARP, delete the **gratuitous-arp-reply** statement from the configuration:

```
[edit interfaces interface-name]
user@host# delete gratuitous-arp-reply;
```

By default, the router or switch responds to gratuitous ARP requests. However, on Ethernet interfaces, you can disable responses to gratuitous ARP requests.

To disable responses to gratuitous ARP requests:

1. In configuration mode, go to the **[edit interfaces interface-name]** hierarchy level.

```
[edit]
user@host# edit interfaces interface-name
```

2. Include the **no-gratuitous-arp-request** statement.

```
[edit interfaces interface-name]
user@host# set no-gratuitous-arp-request
```

To return to the default—that is, to respond to gratuitous ARP requests—delete the **no-gratuitous-arp-request** statement from the configuration:

```
[edit interfaces interface-name]
user@host# delete no-gratuitous-arp-request
```

#### Related Documentation

- [gratuitous-arp-reply on page 981](#)
- [no-gratuitous-arp-request on page 1081](#)
- [Ethernet Interfaces Overview on page 3](#)
- [EX Series Switches Interfaces Overview](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Adjusting the ARP Aging Timer

By default, the ARP aging timer is set at 20 minutes. In environments with many directly attached hosts, such as metro Ethernet environments, increasing the amount of time

between ARP updates by configuring the ARP aging timer can improve performance in an event where having thousands of clients time out at the same time might impact packet forwarding performance. In environments where there are devices connected with lower ARP aging timers (less than 20 minutes), decreasing the ARP aging timer can improve performance by preventing the flooding of traffic toward next hops with expired ARP entries. In most environments, the default ARP aging timer value does not need to be adjusted.

To configure the system-wide ARP aging timer, include the **aging-timer** statement at the **[edit system arp]** hierarchy level:

```
[edit system arp]
user@host# aging-timer minutes
```

The aging timer range is from 1 through 240 minutes. The timer value you configure takes effect as ARP entries expire. In other words, each subsequent refreshed ARP entry receives the new timer value. The new timer value does not apply to ARP entries that exist at the time you commit the configuration.

For more information about statements you can configure at the **[edit system]** hierarchy level, see the *Junos OS Administration Library for Routing Devices*.

**Related  
Documentation**

- *arp (System)*
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Weighted Random Early Detection

On M7i, M10i, M40e, M320, M120, and T Series routers, the Ethernet IQ2 and IQ2-E PIC families extend CoS functionality by supporting network congestion avoidance with weighted random early detection (WRED).

**Related  
Documentation**

- For information on configuring WRED, see the *Class of Service Feature Guide for Routing Devices*.
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Multicast Statistics Collection on Ethernet Interfaces

T Series and TX Matrix routers support multicast statistics collection on Ethernet interfaces in both ingress and egress directions. The multicast statistics functionality can be configured on a physical interface thus enabling multicast accounting for all the logical interfaces below the physical interface.

The multicast statistics information is displayed only when the interface is configured with the **multicast-statistics** statement, which is not enabled by default.



Multicast statistics collection requires at least one logical interface is configured with family inet and/or inet6; otherwise, the commit for **multicast-statistics** will fail.

The multicast in/out statistics can be obtained via interfaces statistics query through CLI and via MIB objects through SNMP query.

To configure multicast statistics:

1. Include the **multicast-statistics** statement at the **[edit interfaces interface-name]** hierarchy level.

An example of a multicast statistics configuration for a Ethernet interface follows:

```
[edit interfaces]
  ge-fpc/pic/port {
    multicast-statistics;
  }
```

To display multicast statistics, use the **show interfaces interface-name statistics detail** command.

#### Related Documentation

- *multicast-statistics*
- [Configuring Multicast Statistics Collection on Aggregated Ethernet Interfaces on page 201](#)
- [Ethernet Interfaces Overview on page 3](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Displaying Internal Ethernet Interfaces for a Routing Matrix with a TX Matrix Plus Router

The router internal Ethernet interface connects the Routing Engine with the router's packet forwarding components. The Junos OS automatically configures internal Ethernet interfaces. For TX Matrix Plus routers, the internal Ethernet interfaces are **ixgbe0** and **ixgbe1**. For T1600 routers configured in a routing matrix, the internal Ethernet interfaces are **bcm0** and **em1**. For more information about internal Ethernet interfaces, see *Understanding Internal Ethernet Interfaces*.



**NOTE:** Do not modify or remove the configuration for the internal Ethernet interface that the Junos OS automatically configures. If you do, the router will stop functioning.

The following example is a sequence of **show interfaces** commands issued in a Junos OS command-line interface (CLI) session with a TX Matrix Plus router in a routing matrix. In the example, the TX Matrix Plus router, which is also called the switch-fabric chassis (SFC), is known by the IP host name **host-sfc-0** and contains redundant Routing Engines. The commands display information about the management Ethernet interface and both internal Ethernet interfaces configured on the Routing Engine to which you are currently logged in:

```
user@host-sfc-0> show interfaces em0 terse
```

```

Interface      Admin Link Proto  Local          Remote
em0            up   up
em0.0          up   up   inet   192.168.35.95/24

```

```
user@host-sfc-0> show interfaces ixgbe0 terse
```

```

Interface      Admin Link Proto  Local          Remote
ixgbe0         up   up
ixgbe0.0       up   up   inet   10.34.0.4/8
                                   162.0.0.4/2
                                   inet6   fe80::200:ff:fe22:4/64
                                   fec0::a:22:0:4/64
                                   tnp     0x22000004

```

```
user@host-sfc-0> show interfaces ixgbe1 terse
```

```

Interface      Admin Link Proto  Local          Remote
ixgbe1         up   up
ixgbe1.0       up   up   inet   10.34.0.4/8
                                   162.0.0.4/2
                                   inet6   fe80::200:1ff:fe22:4/64
                                   fec0::a:22:0:4/64
                                   tnp     0x22000004

```

The following example is a sequence of **show interfaces** commands issued in a CLI session with a T1600 router in a routing matrix. In the example, the T1600 router, which is also called the line-card chassis (LCC), is known by the IP host name **host-sfc-0-lcc-2** and contains redundant Routing Engines.

This T1600 router is connected to the routing matrix through a connection in the TXP-SIB-F13 in slot 2 of the SCC. The commands display information about the management Ethernet interface and both internal Ethernet interfaces configured on the Routing Engine to which you are currently logged in:



**NOTE:** In a routing matrix, the **show interfaces** command displays information about the current router only. If you are logged in to the TX Matrix Plus router, the **show interfaces** command output does not include information about any of the attached T1600 routers. To display interface information about a specific T1600 router in the routing matrix, you must first log in to that router.

The previous example shows a CLI session with the TX Matrix Plus router. To display interface information about the T1600 router known as **host-sfc-0-lcc-2**, first use the **request routing-engine login** command to log in to that LCC.

```

user@host-sfc-0> request routing-engine login lcc 2
--- JUNOS 9.6.I built 2009-06-22 18:13:04 UTC
% cli
warning: This chassis is a Line Card Chassis (LCC) in a multichassis system.
warning: Use of interactive commands should be limited to debugging.
warning: Normal CLI access is provided by the Switch Fabric Chassis (SFC).
warning: Please logout and log into the SFC to use CLI.

```

```
user@host-sfc-0-lcc-2> show interfaces em0 terse
```

Interface	Admin	Link	Proto	Local	Remote
em0	up	up			
em0.0	up	up	inet	192.168.35.117/24	

```
user@host-sfc-0-lcc-2> show interfaces bcm0 terse
```

Interface	Admin	Link	Proto	Local	Remote
bcm0	up	up			
bcm0.0	up	up	inet	10.1.0.5/8	
				129.0.0.5/2	
			inet6	fe80::201:ff:fe01:5/64	
				fec0::a:1:0:5/64	
			tnp	0x1000005	

```
user@host-sfc-0-lcc-2> show interfaces em1 terse
```

Interface	Admin	Link	Proto	Local	Remote
em1	up	up			
em1.0	up	up	inet	10.1.0.5/8	
				129.0.0.5/2	
			inet6	fe80::201:1ff:fe01:5/64	
				fec0::a:1:0:5/64	
			tnp	0x1000005	

**Related Documentation**

- *Understanding Internal Ethernet Interfaces*



## CHAPTER 3

# Configuring the Management Ethernet Interface

- [Management Ethernet Interface Overview on page 25](#)
- [Configuring a Consistent Management IP Address on page 26](#)
- [Configuring the MAC Address on the Management Ethernet Interface on page 27](#)

### Management Ethernet Interface Overview

---

The router's management Ethernet interface, **fxp0** or **em0**, is an out-of-band management interface that needs to be configured only if you want to connect to the router through the management port on the front of the router. You can configure an IP address and prefix length for this interface, which you commonly do when you first install the Junos OS:

```
[edit]
user@host# set interfaces (fxp0 | em0) unit 0 family inet address/prefix-length
[edit]
user@host# show
interfaces {
  (fxp0 | em0) {
    unit 0 {
      family inet {
        address/prefix-length;
      }
    }
  }
}
```

To determine which management interface type is supported on a router, locate the router and Routing Engine combination in *Supported Routing Engines by Router* and note its management Ethernet interface type, either **em0** or **fxp0**.

#### Related Documentation

- [Configuring a Consistent Management IP Address on page 26](#)
- [Configuring the MAC Address on the Management Ethernet Interface on page 27](#)
- [Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a Consistent Management IP Address

On routers with multiple Routing Engines, each Routing Engine is configured with a separate IP address for the management Ethernet interface. To access the master Routing Engine, you must know which Routing Engine is active and use the appropriate IP address.

Optionally, for consistent access to the master Routing Engine, you can configure an additional IP address and use this address for the management interface regardless of which Routing Engine is active. This additional IP address is active only on the management Ethernet interface for the master Routing Engine. During switchover, the address moves to the new master Routing Engine.



**NOTE:** For M Series, MX Series, and most T Series routers, the management Ethernet interface is `fxp0`. For TX Matrix Plus routers and T1600 or T4000 routers configured in a routing matrix, the management Ethernet interface is `em0`.



**NOTE:** Automated scripts that you have developed for standalone T1600 routers (T1600 routers that are not in a routing matrix) might contain references to the `fxp0` management Ethernet interface. Before reusing the scripts on T1600 routers in a routing matrix, edit the command lines that reference the `fxp0` management Ethernet interface so that the commands reference the `em0` management Ethernet interface instead.

To configure an additional IP address for the management Ethernet interface, include the **master-only** statement at the **[edit groups]** hierarchy level.

In the following example, IP address **10.17.40.131** is configured for both Routing Engines and includes a **master-only** statement. With this configuration, the **10.17.40.131** address is active only on the master Routing Engine. The address remains consistent regardless of which Routing Engine is active. IP address **10.17.40.132** is assigned to **fxp0** on **re0**, and address **10.17.40.133** is assigned to **fxp0** on **re1**.

```
[edit groups re0 interfaces fxp0]
unit 0 {
  family inet {
    address 10.17.40.131/25 {
      master-only;
    }
    address 10.17.40.132/25;
  }
}
[edit groups re1 interfaces fxp0]
unit 0 {
  family inet {
    address 10.17.40.131/25 {
      master-only;
    }
  }
}
```

```

        address 10.17.40.133/25;
    }
}

```

This feature is available on all routers that include dual Routing Engines. On the TX Matrix router, this feature is applicable to the switch-card chassis (SCC) only.

#### Related Documentation

- [Management Ethernet Interface Overview on page 25](#)
- [Configuring the MAC Address on the Management Ethernet Interface on page 27](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the MAC Address on the Management Ethernet Interface

By default, the router's management Ethernet interface uses as its MAC address the MAC address that is burned into the Ethernet card.



**NOTE:** For M Series, MX Series, and most T Series routers, the management Ethernet interface is `fxp0`. For TX Matrix Plus routers and T1600 routers configured in a routing matrix, and TX Matrix Plus routers with 3D SIBs, T1600 routers, and T4000 routers configured in a routing matrix, the management Ethernet interface is `em0`.



**NOTE:** Automated scripts that you have developed for standalone T1600 routers (T1600 routers that are not in a routing matrix) might contain references to the `fxp0` management Ethernet interface. Before reusing the scripts on T1600 routers in a routing matrix, edit the command lines that reference the `fxp0` management Ethernet interface so that the commands reference the `em0` management Ethernet interface instead.

To display the MAC address used by the router's management Ethernet interface, enter the **show interface fxp0** or **show interface em0** operational mode command.

To change the management Ethernet interface's MAC address, include the **mac** statement at the **[edit interfaces fxp0]** or **[edit interfaces em0]** hierarchy level:

```

[edit interfaces (fxp0 | em0)]
  mac mac-address;

```

Specify the MAC address as six hexadecimal bytes in one of the following formats: `nnnn.nnnn.nnnn` (for example, `0011.2233.4455`) or `nn:nn:nn:nn:nn:nn` (for example, `00:11:22:33:44:55`).



**NOTE:** If you integrate a standalone T640 router into a routing matrix, the PIC MAC addresses for the integrated T640 router are derived from a pool of MAC addresses maintained by the TX Matrix router. For each MAC address you specify in the configuration of a formerly standalone T640 router, you must specify the same MAC address in the configuration of the TX Matrix router.

Similarly, if you integrate a standalone T1600 router into a routing matrix, the PIC MAC addresses for the integrated T1600 router are derived from a pool of MAC addresses maintained by the TX Matrix Plus router. For each MAC address you specify in the configuration of a formerly standalone T1600 router, you must specify the same MAC address in the configuration of the TX Matrix Plus router.

---

**Related  
Documentation**

- [Management Ethernet Interface Overview on page 25](#)
- [Configuring a Consistent Management IP Address on page 26](#)
- [Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*



## CHAPTER 4

# Enabling Passive Monitoring on Ethernet Interfaces

- [Passive Monitoring on Ethernet Interfaces Overview on page 29](#)
- [Enabling Passive Monitoring on Ethernet Interfaces on page 31](#)

### Passive Monitoring on Ethernet Interfaces Overview

---

The Monitoring Services I and Monitoring Services II PICs are designed to enable IP services. You can monitor IPv4 traffic if you have a Monitoring Services PIC installed in the router with the following PICs:

- 10-port Gigabit Ethernet PIC with SFPs
- 4-port Gigabit Ethernet PIC with SFPs
- 2-port Gigabit Ethernet PIC with SFPs
- 1-port 10-Gigabit Ethernet PIC



**NOTE:** The PICs in the preceding list support only IPv4.



**NOTE:** I2.0 based M120 routers and I3.0 based M320 routers with the PICs in the preceding list support passive monitoring starting with Junos OS Release 9.5. Other M Series and T Series routers with the PICs listed above started supporting passive monitoring before Junos OS Release 7.3. Support for 1-port 10-Gigabit Ethernet PIC with XENPAK on I2.0-based M120 routers and I3.0-based M320 routers was added in Junos OS Release 9.5.

- 4-port 10-Gigabit Ethernet LAN/WAN PIC with XFP (T640, T1600, and T4000 Core Routers) (supported on both WAN-PHY and LAN-PHY modes for both IPv4 and IPv6 addresses)

The following interfaces support passive monitoring on the I3.0-based MX 240, MX 480, and MX 960 routers, starting with Junos OS Release 8.5:

- Type 2 MX FPCs
- Type 3 MX FPCs
- Gigabit Ethernet Enhanced DPC with SFP (DPCE-R-40GE-SFP)
- 4-port 10-Gigabit Ethernet Enhanced DPCs with XFP (DPCE-R-4XGE-XFP)

The following interfaces support passive monitoring on the Trio-based MX 240, MX 480, and MX 960 routers:

- 10-Gigabit Ethernet MPC with SFP+
- 30-Gigabit Ethernet MPC
- 60-Gigabit Ethernet MPC

Passive monitoring is also supported on MX 80 routers with 10-Gigabit Ethernet MPC with SFP+ and 30-Gigabit Ethernet MPC interfaces.

Interfaces configured on the following FPCs and PIC support IPv6 passive monitoring on the T640, T1600, and T4000 routers:

- Enhanced Scaling FPC2
- Enhanced Scaling FPC3
- Enhanced Scaling FPC4
- Enhanced Scaling FPC4.1
- Enhanced II FPC1 (T640 and T1600 routers)
- Enhanced II FPC2 (T640 and T1600 routers)
- Enhanced II FPC3 (T640 and T1600 routers)
- 4-port 10-Gigabit Ethernet LAN/WAN PIC with XFP (supported on both WAN-PHY and LAN-PHY modes for both IPv4 and IPv6 addresses)
- Gigabit Ethernet PIC with SFP
- 10-Gigabit Ethernet PIC with XENPAK (T640 and T1600 routers)
- SONET/SDH OC192/STM64 PICs with XFP (T1600 and T4000 routers)
- SONET/SDH OC48c/STM16 PIC with SFP
- SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP (T1600 router)
- Type 1 SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP (T1600 router)



**NOTE:** Unlike IPv4 passive monitoring, IPv6 passive monitoring is not supported on Monitoring Services PICs. You must configure port mirroring to forward the packets from the passive monitored ports to other interfaces.

---

**Related  
Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*

## Enabling Passive Monitoring on Ethernet Interfaces

When you configure an interface in passive monitoring mode, the Packet Forwarding Engine silently drops packets coming from that interface and destined to the router itself. Passive monitoring mode also stops the Routing Engine from transmitting any packet from that interface. Packets received from the monitored interface can be forwarded to monitoring interfaces. If you include the **passive-monitor-mode** statement in the configuration:

- Gigabit and Fast Ethernet interfaces can support both per-port passive monitoring and per-VLAN passive monitoring. The destination MAC filter on the receive port of the Ethernet interfaces is disabled.
- Ethernet encapsulation options are not allowed.
- Ethernet interfaces do not support the **stacked-vlan-tagging** statement for both IPv4 and IPv6 packets in passive monitor mode.

To enable packet flow monitoring on Ethernet interfaces:

1. In configuration mode, go to the **[edit interfaces interface-name]** hierarchy level.

```
[edit]
user@host# edit interfaces interface-name
```

2. Include the **passive-monitor-mode** statement.

```
[edit interfaces interface-name]
user@host# set passive-monitor-mode
```

For IPv4 monitoring services interfaces, enable packet flow monitoring by including the **family** statement at the **[edit interfaces mo-fpc/pic/port unit logical-unit-number]** hierarchy level, specifying the **inet** option:

1. In configuration mode, go to the **[edit interfaces mo-fpc/pic/port unit logical-unit-number]** hierarchy level.

```
[edit]
user@host# edit interfaces mo-fpc/pic/port unit logical-unit-number
```

2. Include the **passive-monitor-mode** statement.

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number]
user@host# set family inet
```

For conformity with the cflowd record structure, you must include the **receive-options-packets** and **receive-ttl-exceeded** statements at the **[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]** hierarchy level:

1. In configuration mode, go to the **[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]** hierarchy level.

```
[edit]
user@host# edit interfaces mo-fpc/pic/port unit logical-unit-number family inet
```

2. Include the **receive-options-packets** and **receive-ttl-exceeded** statements.

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]
user@host# set receive-options-packets
user@host# set receive-ttl-exceeded
```

IPv6 passive monitoring is not supported on monitoring services PICs. A user must configure port mirroring to forward the packets from the passive monitored ports to other interfaces.

For information on FPCs and PICs that support IPv6 passive monitoring on the T640, T1600, and T4000 routers, see [“Passive Monitoring on Ethernet Interfaces Overview” on page 29](#). Interfaces configured on these FPCs and PICs support IPv6 passive monitoring.

To configure port mirroring, include the **port-mirroring** statement at the **[edit forwarding-options]** hierarchy level.

For the monitoring services interface, you can configure multiservice physical interface properties. For more information, see *Configuring Multiservice Physical Interface Properties* and the *Junos OS Services Interfaces Library for Routing Devices*.

**Related  
Documentation**

- [Passive Monitoring on Ethernet Interfaces Overview on page 29](#)
- *Configuring Multiservice Physical Interface Properties*
- *Junos OS Services Interfaces Library for Routing Devices*
- *Ethernet Interfaces Feature Guide for Routing Devices*

## CHAPTER 5

# Configuring IEEE 802.1x Port-Based Network Access Control

- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
- [Understanding the Administrative State of the Authenticator Port on page 34](#)
- [Understanding the Administrative Mode of the Authenticator Port on page 34](#)
- [Configuring the Authenticator on page 35](#)
- [Viewing the dot1x Configuration on page 35](#)

## IEEE 802.1x Port-Based Network Access Control Overview

---

MX Series routers support the IEEE 802.1x Port-Based Network Access Control (dot1x) protocol on Ethernet interfaces for validation of client and user credentials to prevent unauthorized access to a specified router port. Before authentication is complete, only 802.1x control packets are allowed and forwarded to the router control plane for processing. All other packets are dropped.

Authentication methods used must be 802.1x compliant. Authentication using RADIUS and Microsoft Active Directory servers is supported. The following user/client authentication methods are allowed:

- EAP-MD5 (RFC 3748)
- EAP-TTLS requires a server certificate (RFC 2716)
- EAP-TLS requires a client and server certificate
- PEAP requires only a server certificate

You can use both client and server certificates in all types of authentication except EAP-MD5.



**NOTE:** On the MX Series router, 802.1x can be enabled on bridged ports only and not on routed ports.

Dynamic changes to a user session are supported to allow the router administrator to terminate an already authenticated session by using the “RADIUS disconnect” message defined in RFC 3576.

**Related  
Documentation**

- [Understanding the Administrative State of the Authenticator Port on page 34](#)
- [Understanding the Administrative Mode of the Authenticator Port on page 34](#)
- [Configuring the Authenticator on page 35](#)
- [Viewing the dot1x Configuration on page 35](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Understanding the Administrative State of the Authenticator Port

The administrative state of an authenticator port can take any of the following three states:

- Force authorized—Allows network access to all users of the port without requiring them to be authenticated. This is equivalent to not having any authentication enabled on the port.
- Force unauthorized—Denies network access to all users of the port. This is equivalent to disabling the port.
- Automatic—This is the default mode where the authentication server response determines if the port is opened for traffic or not. Only the successfully authenticated clients are allowed access, all others are denied.

In Junos OS, the default mode is “automatic.” The “force authorized” and “force unauthorized” admin modes are not supported. You can achieve the functionality of “force authorized” mode by disabling **dot1x** on the required port. You can achieve the functionality of “force unauthorized” mode by disabling the port itself.

**Related  
Documentation**

- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
- [Understanding the Administrative Mode of the Authenticator Port on page 34](#)
- [Configuring the Authenticator on page 35](#)
- [Viewing the dot1x Configuration on page 35](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Understanding the Administrative Mode of the Authenticator Port

Junos OS supports the supplicant mode “single” and not the “single secure” nor “multiple” modes. The “Single” mode option authenticates only the first client that connects to a port. All other clients that connect later (802.1x compliant or noncompliant) are allowed free access on that port without any further authentication. If the first authenticated client logs out, all other users are locked out until a client authenticates again.

- Related Documentation**
- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
  - [Understanding the Administrative State of the Authenticator Port on page 34](#)
  - [Configuring the Authenticator on page 35](#)
  - [Viewing the dot1x Configuration on page 35](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the Authenticator

To configure the IEEE 802.1x Port-Based Network Access Control protocol on Ethernet interfaces you must configure the **authenticator** statement at the **[edit protocols dot1x]** hierarchy level. Use the **authentication-profile-name** *access-profile-name* statement to specify the authenticating RADIUS server, and use the **interface** statement to specify and configure the Gigabit Ethernet or Fast Ethernet interface on the router specifically for IEEE 802.1x protocol use; both at the **[edit protocols dot1x authenticator]** hierarchy level.

```
[edit protocols dot1x]
authenticator {
  authentication-profile-name access-profile-name;
  interface (xe-fpc/pic/port | ge-fpc/pic/port | fe-fpc/pic/port) {
    maximum-requests seconds;
    quiet-period seconds;
    reauthentication (disable | interval seconds);
    retries integer;
    server-timeout seconds;
    supplicant (single);
    supplicant-timeout seconds;
    transmit-period seconds;
  }
}
```

- Related Documentation**
- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
  - [Understanding the Administrative State of the Authenticator Port on page 34](#)
  - [Understanding the Administrative Mode of the Authenticator Port on page 34](#)
  - [Viewing the dot1x Configuration on page 35](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Viewing the dot1x Configuration

**Purpose** To review and verify the dot1x configuration.

**Action** To view all **dot1x** configurations, use the **show dot1x interface** operational mode command. To view a **dot1x** configuration for a specific interface, use the **show dot1x interface (xe-fpc/pic/port | ge-fpc/pic/port | fe-fpc/pic/port) detail** operational mode command. See the *Network Interfaces Command Reference* for more information about this command.

**Related  
Documentation**

- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
- [Understanding the Administrative State of the Authenticator Port on page 34](#)
- [Understanding the Administrative Mode of the Authenticator Port on page 34](#)
- [Configuring the Authenticator on page 35](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*



## CHAPTER 6

# Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode

- [802.1X for MX Series Routers in Enhanced LAN Mode Overview on page 39](#)
- [Understanding 802.1X and LLDP and LLDP-MED on MX Series Routers in Enhanced LAN Mode on page 41](#)
- [Understanding 802.1X and RADIUS Accounting on MX Series Routers in Enhanced LAN Mode on page 44](#)
- [Understanding 802.1X and VoIP on MX Series Routers in Enhanced LAN Mode on page 45](#)
- [Understanding Guest VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode on page 46](#)
- [Understanding Dynamic VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode on page 47](#)
- [Understanding Server Fail Fallback and Authentication on MX Series Routers in Enhanced LAN Mode on page 47](#)
- [Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode on page 48](#)
- [Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode on page 50](#)
- [Configuring LLDP-MED on MX Series Routers in Enhanced LAN Mode on page 51](#)
- [Configuring LLDP on MX Series Routers in Enhanced LAN Mode on page 52](#)
- [Configuring Server Fail Fallback on MX Series Routers in Enhanced LAN Mode on page 55](#)
- [Understanding Captive Portal Authentication on the MX Series Routers on page 56](#)
- [Understanding Authentication Session Timeout on MX Series Routers on page 57](#)
- [Authentication Process Flow for MX Series Routers in Enhanced LAN Mode on page 58](#)
- [Specifying RADIUS Server Connections on an MX Series Router in Enhanced LAN Mode on page 60](#)
- [Configuring Captive Portal Authentication on MX Series Routers in Enhanced LAN Mode on page 61](#)

- [Designing a Captive Portal Authentication Login Page on an MX Series Router on page 63](#)
- [Configuring Static MAC Bypass of Authentication on MX Series Routers in Enhanced LAN Mode on page 65](#)
- [Controlling Authentication Session Timeouts on an MX Series Router in Enhanced LAN Mode on page 65](#)
- [Configuring MAC RADIUS Authentication on MX Series Routers in Enhanced LAN Mode on page 67](#)
- [Example: Configuring MAC RADIUS Authentication on an MX Series Router on page 68](#)
- [Example: Setting Up Captive Portal Authentication on an MX Series Router on page 73](#)
- [Example: Connecting a RADIUS Server for 802.1X to an MX Series Router on page 77](#)
- [Example: Setting Up 802.1X in Conference Rooms to Provide Internet Access to Corporate Visitors on an MX Series Router on page 79](#)
- [Example: Configuring Static MAC Bypass of Authentication on an MX Series Router on page 83](#)
- [Example: Applying Firewall Filters to Multiple Supplicants on Interfaces Enabled for 802.1X or MAC RADIUS Authentication on MX Series Routers on page 86](#)

## 802.1X for MX Series Routers in Enhanced LAN Mode Overview

IEEE 802.1X provides network edge security, protecting Ethernet LANs from unauthorized user access. Support is implemented for controlling access to your network through an MX Series router by using several different authentication methods, such as 802.1X, MAC RADIUS, or a captive portal.

This functionality is supported on the following MPCs on MX240, MX480, and MX960 routers in enhanced LAN mode:

- MPC4E with two 100-Gigabit Ethernet ports and eight 10-Gigabit Ethernet ports
- MPC4E with thirty-two 10-Gigabit Ethernet ports
- MPC3E that contains a 2-port 40-Gigabit Ethernet MIC with QSFP+
- MPC1E with forty 1-Gigabit Ethernet ports or twenty 1-Gigabit Ethernet ports

You must reboot the router when you configure or delete the enhanced LAN mode on the router. Configuring the **network-services lan** option implies that the system is running in the enhanced IP mode. When you configure a device to function in MX-LAN mode, only the supported configuration statements and operational show commands that are available for enabling or viewing in this mode are displayed in the CLI interface. If your system contains parameters that are not supported in MX-LAN mode in a configuration file, you cannot commit those unsupported attributes. You must remove the settings that are not supported and then commit the configuration. After the successful CLI commit, a system reboot is required for the attributes to be come effective. Similarly, if you remove the **network-services lan** statement, the system does not run in MX-LAN mode. Therefore, all of the settings that are supported outside of the MX-LAN mode are displayed and are available for definition in the CLI interface. If your configuration file contains settings that are supported only in MX-LAN mode, you must remove those attributes before you commit the configuration. After the successful CLI commit, a system reboot will be required for the CLI settings to take effect. The Layer 2 Next-Generation CLI configuration settings are supported in MX-LAN mode. As a result, the typical MX Series-format of CLI configurations might differ in MX-LAN mode.

This functionality is supported on an MX Series Virtual Chassis combination that functions in enhanced LAN mode (by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level). Port-based network access control is supported on MX240, MX480, and MX960 routers with MPCs in both the MX-LAN mode and the non-MX-LAN mode (with other supported network services modes on MPCs on these routers). To configure the IEEE 802.1x port-based network access control (PNAC) protocol on Ethernet interfaces, you must configure the **authenticator** statement at the **[edit protocols authentication-access- control]** hierarchy level. You can also configure captive portal authentication on a router so that users connected to the switch are authenticated before being allowed to access the network. You can also configure Junos Pulse Access Control Service as the access policy to authenticate and authorize users connected to the switch for admission to the network and for access to protected network resources by using the **uac-policy** statement.

## How 802.1X Authentication Works

802.1X authentication works by using an *Authenticator Port Access Entity* (the switch) to block all traffic to and from a supplicant (end device) at the port until the supplicant's credentials are presented and matched on the *Authentication server* (a RADIUS server). When authenticated, the switch stops blocking traffic and opens the port to the supplicant.

The end device is authenticated in either *single* mode, *single-secure* mode, or *multiple* mode:

- **single**—Authenticates only the first end device. All other end devices that connect later to the port are allowed full access without any further authentication. They effectively “piggyback” on the end devices’ authentication.
- **single-secure**—Allows only one end device to connect to the port. No other end device is allowed to connect until the first logs out.
- **multiple**—Allows multiple end devices to connect to the port. Each end device will be authenticated individually.

Network access can be further defined using VLANs and firewall filters, which both act as filters to separate and match groups of end devices to the areas of the LAN they require. For example, you can configure VLANs to handle different categories of authentication failures depending upon:

- Whether or not the end device is 802.1X-enabled.
- Whether or not MAC RADIUS authentication has been configured on the switch interfaces to which the hosts are connected.
- Whether the RADIUS authentication server becomes unavailable or sends a RADIUS access-reject message. See *Configuring RADIUS Server Fail Fallback (CLI Procedure)*.

## 802.1X Features Overview



**NOTE:** The 802.1X features available on the MX Series routers depend upon which switch you are using.

802.1X features on Juniper Networks MX Series routers are:

- **Guest VLAN**—Provides limited access to a LAN, typically just to the Internet, for nonresponsive end devices that are not 802.1X-enabled when MAC RADIUS authentication has not been configured on the switch interfaces to which the hosts are connected. Also, a guest VLAN can be used to provide limited access to a LAN for guest users. Typically, the guest VLAN provides access just to the Internet and to other guests’ end devices.
- **Server-reject VLAN**—Provides limited access to a LAN, typically just to the Internet, for responsive end devices that are 802.1X-enabled but that have sent the wrong credentials.
- **Server-fail VLAN**—Provides limited access to a LAN, typically just to the Internet, for 802.1X end devices during a RADIUS server timeout.

- Dynamic VLAN—Enables an end device, after authentication, to be a member of a VLAN dynamically.
- Private VLAN—Enables configuration of 802.1X authentication on interfaces that are members of private VLANs (PVLANS).
- Dynamic changes to a user session—Allows the switch administrator to terminate an already authenticated session. This feature is based on support of the RADIUS Disconnect Message defined in RFC 3576.
- RADIUS accounting—Sends accounting information to the RADIUS accounting server. Accounting information is sent to the server whenever a subscriber logs in or logs out and whenever a subscriber activates or deactivates a subscription.

### Supported Features Related to 802.1X Authentication

802.1X does not replace other security technologies. 802.1X works together with port security features, such as DHCP snooping, dynamic ARP inspection (DAI), and MAC limiting, to guard against spoofing.

Supported features related to authentication include:

- Static MAC bypass—Provides a bypass mechanism to authenticate devices that are not 802.1X-enabled (such as printers). Static MAC bypass connects these devices to 802.1X-enabled ports, bypassing 802.1X authentication.
- MAC RADIUS authentication—Provides a means to enable or disable MAC authentication independently of whether 802.1X authentication is enabled.

### Understanding 802.1X and LLDP and LLDP-MED on MX Series Routers in Enhanced LAN Mode

---

Juniper Networks MX Series routers use Link Layer Discovery Protocol (LLDP) and Link Layer Discovery Protocol—Media Endpoint Discovery (LLDP-MED) to learn and distribute device information on network links. The information allows the router to quickly identify a variety of devices, resulting in a LAN that interoperates smoothly and efficiently.

LLDP-capable devices transmit information in type, length, and value (TLV) messages to neighbor devices. Device information can include information such as chassis and port identification and system name and system capabilities. The TLVs leverage this information from parameters that have already been configured in the Juniper Networks Junos operating system (Junos OS).

LLDP-MED goes one step further than LLDP, exchanging IP-telephony messages between the router and the IP telephone.

LLDP and LLDP-MED also provide PoE power management capabilities. LLDP power negotiation allows the router to manage PoE power by negotiating with LLDP-enabled powered devices to dynamically allocate PoE power as needed. LLDP power priority allows an LLDP-enabled powered device to set the PoE power priority on the router interface to which it connects.

The router also uses these protocols to ensure that voice traffic gets tagged and prioritized with the correct values at the source itself. For example, 802.1p CoS and 802.1Q tag information can be sent to the IP telephone.

EX Series routers support the following basic TLVs:

- **Chassis Identifier**—The MAC address associated with the local system.



**NOTE:** The Chassis ID TLV has a subtype for Network Address Family. LLDP frames are validated only if this subtype has a value of 1 (IPv4) or 2 (IPv6). For any other value, the transmitting device is detected by LLDP as a neighbor and displayed in the output of the "show lldp neighbors" command, but is not assigned to the VLAN.

- **Port Identifier**—The port identification for the specified port in the local system.
- **Port Description**—Textual description of the interface or the logical unit. The description for the logical unit is used, if available; otherwise, the Port Description TLV will contain the description configured on the physical interface. For example, LAG member interfaces do not contain a logical unit, so only the description configured on the physical interface can be used.
- **System Name**—The user-configured name of the local system. The system name can be a maximum of 256 characters.
- **System Description**—The system description containing information about the software and current image running on the system. This information is not configurable, but taken from the software.
- **System Capabilities**—The primary function performed by the system. The capabilities that system supports; for example, bridge or router. This information is not configurable, but based on the model of the product.
- **Management Address**—The IPv4 or IPv6 management address of the local system.

EX Series routers support the following 802.3 TLVs:

- **Power via MDI**—A TLV that advertises MDI power support, PSE power pair, and power class information.
- **MAC/PHY Configuration Status**—A TLV that advertises information about the physical interface, such as autonegotiation status and support and MAU type. The information is not configurable, but based on the physical interface structure.



**NOTE:** The MAC/PHY Configuration Status TLV has a subtype for the PMD Auto-Negotiation Advertised Capability field. This field will contain a value of **other** or **unknown** if the LLDP packet was transmitted from a 10-gigabit SFP+ port.

- **Link Aggregation**—A TLV that advertises if the port is aggregated and its aggregated port ID.

- **Maximum Frame Size**—A TLV that advertises the Maximum Transmission Unit (MTU) of the interface sending LLDP frames.
- **Port Vlan**—A TLV that advertises the VLAN name configured on the interface.

EX Series routers support the following LLDP-MED TLVs:

- **LLDP MED Capabilities**—A TLV that advertises the primary function of the port. The capabilities values range 0 through 15:
  - **0**— Capabilities
  - **1**— Network Policy
  - **2**— Location Identification
  - **3**— Extended Power via MDI-PSE
  - **4**— Inventory
  - **5–15**— Reserved
- **LLDP-MED Device Class Values:**
  - **0**— Class not defined.
  - **1**— Class 1 Device.
  - **2**— Class 2 Device.
  - **3**— Class 3 Device.
  - **4**— Network Connectivity Device
  - **5–255**— Reserved.
- **Network Policy**—A TLV that advertises the port VLAN configuration and associated Layer 2 and Layer 3 attributes. Attributes include the policy identifier, application types, such as voice or streaming video, 802.1Q VLAN tagging, and 802.1p priority bits and Diffserv code points.
- **Endpoint Location**— A TLV that advertises the physical location of the endpoint.
- **Extended Power via MDI**— A TLV that advertises the power type, power source, power priority, and power value of the port. It is the responsibility of the PSE device (network connectivity device) to advertise the power priority on a port.

## Understanding 802.1X and RADIUS Accounting on MX Series Routers in Enhanced LAN Mode

---

Juniper Networks MX Series routers support IETF RFC 2866, *RADIUS Accounting*. Configuring RADIUS accounting on an EX Series switch permits statistical data about users logging onto or off a LAN to be collected and sent to a RADIUS accounting server. The statistical data gathered can be used for general network monitoring, to analyze and track usage patterns, or to bill a user based upon the amount of time or type of services accessed.

To configure RADIUS accounting, specify one or more RADIUS accounting servers to receive the statistical data from the switch, and select the type of accounting data to be collected.

The RADIUS accounting server you specify can be the same server used for RADIUS authentication, or it can be a separate RADIUS server. You can specify a list of RADIUS accounting servers. In the event that the primary server (the first one configured) is unavailable, each RADIUS server in the list is tried in the order in which they are configured in the Juniper Networks Junos operating system (Junos OS).

The RADIUS accounting process between a switch and a RADIUS server works like this:

1. A RADIUS accounting server listens for User Datagram Protocol (UDP) packets on a specific port. For example, on FreeRADIUS, the default port is 1813.
2. The switch forwards an *accounting-request* packet containing an event record to the accounting server. For example, a supplicant is authenticated through 802.1X authentication and connected to the LAN. The event record associated with this supplicant contains an *Acct-Status-Type* attribute whose value indicates the beginning of user service for this supplicant. When the supplicant's session ends, the accounting request will contain an *Acct-Status-Type* attribute value indicating the end of user service. The RADIUS accounting server records this as a stop-accounting record containing session information and the length of the session.
3. The RADIUS accounting server logs these events as start-accounting or stop-accounting records. The records are in a file. On FreeRADIUS, the file name is the server's address; for example, 122.69.1.250.
4. The accounting server sends an *accounting-response* packet back to the switch confirming it has received the accounting request.
5. If the switch does not receive a response from the server, it continues to send accounting requests until an accounting response is returned from the accounting server.

The statistics collected through this process can be displayed from the RADIUS server; to see those statistics, the user accesses the log file configured to receive them.



## Understanding 802.1X and VoIP on MX Series Routers in Enhanced LAN Mode

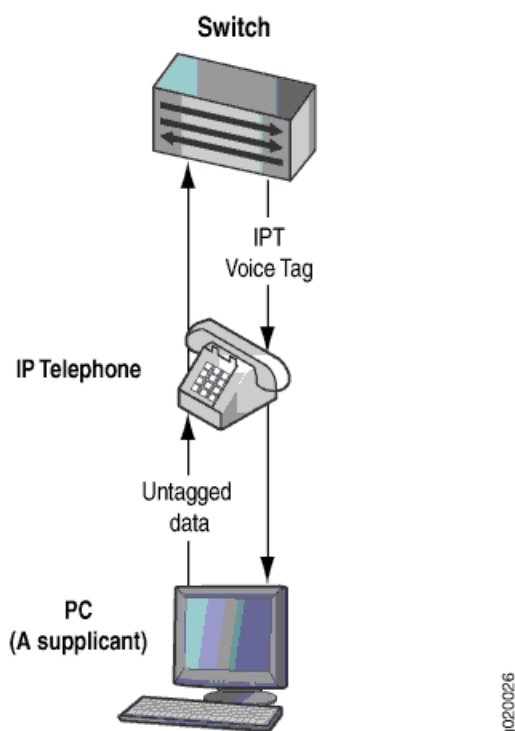
When you use Voice over IP (VoIP), you can connect IP telephones to the router and configure IEEE 802.1X authentication for 802.1X-compatible IP telephones. The 802.1X authentication provides network edge security, protecting Ethernet LANs from unauthorized user access.

VoIP is a protocol used for the transmission of voice through packet-switched networks. VoIP transmits voice calls using a network connection instead of an analog phone line.

When VoIP is used with 802.1X, the RADIUS server authenticates the phone, and Link Layer Discovery Protocol–Media Endpoint Discovery (LLDP-MED) provides the class-of-service (CoS) parameters to the phone.

You can configure 802.1X authentication to work with VoIP in multiple supplicant or single supplicant mode. In *multiple-supplicant* mode, the 802.1X process allows multiple supplicants to connect to the interface. Each supplicant will be authenticated individually. For an example of a VoIP multiple supplicant topology, see [Figure 1 on page 45](#).

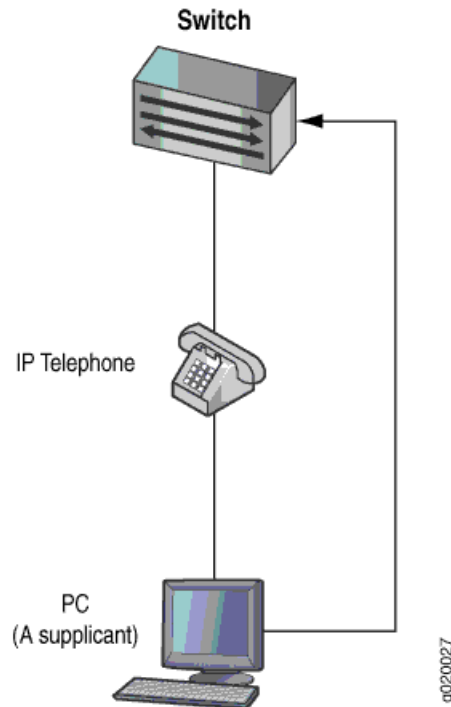
**Figure 1: VoIP Multiple Supplicant Topology**



If an 802.1X-compatible IP telephone does not have an 802.1X host but has another 802.1X-compatible device connected to its data port, you can connect the phone to an interface in single-supplicant mode. In *single-supplicant* mode, the 802.1X process authenticates only the first supplicant. All other supplicants who connect later to the interface are allowed full access without any further authentication. They effectively

“piggyback” on the first supplicant’s authentication. For an example of a VoIP single supplicant topology, see [Figure 2 on page 46](#).

**Figure 2: VoIP Single Supplicant Topology**



If an IP telephone does not support 802.1X, you can configure VoIP to bypass 802.1X and LLDP-MED and have the packets forwarded to a VoIP VLAN,

## Understanding Guest VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode

Guest VLANs can be configured on switches that are using 802.1X authentication to provide limited access—typically only to the Internet—for:

- Corporate guests
- End devices that are not 802.1X-enabled
- Nonresponsive end devices when MAC RADIUS authentication has not been configured on the switch interfaces to which the hosts are connected

A guest VLAN is not used for supplicants sending incorrect credentials. Those supplicants are directed to the server-reject VLAN instead.

For end devices that are not 802.1X-enabled, a guest VLAN can allow limited access to a server from which the non-802.1X-enabled end device can download the supplicant software and attempt authentication again.

A guest VLAN is not used when MAC RADIUS authentication has been configured on the switch interfaces to which the hosts are connected. Some end devices, such as a printer,

cannot be enabled for 802.1X. The hosts for such devices should be connected to switch interfaces that are configured for MAC RADIUS authentication.

## Understanding Dynamic VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode

---

Dynamic VLANs, in conjunction with the 802.1X authentication process, provide secure access to the LAN for end devices belonging to different VLANs on a single port.

When this feature is configured on the RADIUS server, an end device or user authenticating on the RADIUS server is assigned to the VLAN configured for it. The end device or user becomes a member of a VLAN dynamically after successful 802.1X authentication. For information on configuring dynamic VLANs on your RADIUS server, see the documentation for your RADIUS server.

Successful authentication requires that the VLAN ID or VLAN name exist on the router and match the VLAN ID or VLAN name sent by the RADIUS server during authentication. If neither exists, the end device is unauthenticated. If a guest VLAN is established, the unauthenticated end device is automatically moved to the guest VLAN.

## Understanding Server Fail Fallback and Authentication on MX Series Routers in Enhanced LAN Mode

---

Server fail fallback allows you to specify how end devices connected to the router are supported if the RADIUS authentication server becomes unavailable or sends a RADIUS access-reject message.

Juniper Networks MX Series routers in enhanced LAN mode use authentication to implement access control in an enterprise network. If 802.1X, MAC RADIUS, or captive portal authentication are configured on the interface, end devices are evaluated at the initial connection by an authentication (RADIUS) server. If the end device is configured on the authentication server, the device is granted access to the LAN and the MX Series router opens the interface to permit access.

A RADIUS server timeout occurs if no RADIUS authentication servers are reachable when an end device logs in and attempts to access the LAN. Server fail fallback allows you to specify one of four actions to be taken toward end devices awaiting authentication when the server is timed out:

- *Permit* authentication, allowing traffic to flow from the end device through the interface as if the end device were successfully authenticated by the RADIUS server.
- *Deny* authentication, preventing traffic from flowing from the end device through the interface. This is the default.
- *Move* the end device to a specified VLAN. (The VLAN must already exist on the router.)
- *Sustain* authenticated end devices that already have LAN access and *deny* unauthenticated end devices. If the RADIUS servers time out during reauthentication, previously authenticated end devices are reauthenticated and new users are denied LAN access.

Server fail fallback is triggered most often during reauthentication when the already configured and in-use RADIUS server becomes inaccessible. However, server fail fallback can also be triggered by an end device's first attempt at authentication through the RADIUS server.

Server fail fallback allows you to specify that an end device be moved to a specified VLAN if the router receives a RADIUS access-reject message. The configured VLAN name overrides any attributes sent by the server.

## **Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode**

RADIUS accounting permits statistical data about users logging onto or off a LAN to be collected and sent to a RADIUS accounting server. The statistical data gathered can be used for general network monitoring, to analyze and track usage patterns, or to bill a user based upon the amount of time or type of services accessed.

To configure basic RADIUS accounting using the CLI:

1. Specify the accounting servers to which the switch will forward accounting statistics:

```
[edit access ]
user@router# set profile profile1 radius accounting-server accounting-server [122.69.1.250
122.69.1.252]
```

2. Define the RADIUS accounting servers:

```
[edit access]
user@router# set radius-server 122.69.1.250 secret juniper
user@router# set radius-server 122.69.1.252 secret juniper1
```

3. Enable accounting for an access profile:

```
[edit access]
user@router# set profile profile1 accounting
```

4. Configure the RADIUS servers to use while sending accounting messages and updates:

```
[edit access]
user@router# set profile profile1 accounting order radius
```

5. Configure the statistics to be collected on the router and forwarded to the accounting server:

```
[edit access ]
user@router# set profile profile1 accounting accounting-stop-on-access-deny
user@router# set profile profile1 accounting accounting-stop-on-failure
```

6. Display accounting statistics collected on the router:

```
user@router> show network-access aaa statistics accounting
Accounting module statistics
  Requests received: 1
  Accounting Response failures: 0
  Accounting Response Success: 1
  Requests timedout: 0
```

7. Open an accounting log on the RADIUS accounting server using the server's address, and view accounting statistics:

```
[root@freeradius]# cd /usr/local/var/log/radius/radacct/122.69.1.250
[root@freeradius 122.69.1.250]# ls
```

detail-20071214

[root@freeradius 122.69.1.250]# vi details-20071214

```
User-Name = "000347e1bab9"
NAS-Port = 67
Acct-Status-Type = Stop
Acct-Session-Id = "802.1x811912"
Acct-Input-Octets = 17454
Acct-Output-Octets = 4245
Acct-Session-Time = 1221041249
Acct-Input-Packets = 72
Acct-Output-Packets = 53
Acct-Terminate-Cause = Lost-Carrier
Acct-Input-Gigawords = 0
Acct-Output-Gigawords = 0
Called-Station-Id = "00-19-e2-50-52-60"
Calling-Station-Id = "00-03-47-e1-ba-b9"
Event-Timestamp = "Sep 10 2008 16:52:39 PDT"
NAS-Identifier = "esp48t-1b-01"
NAS-Port-Type = Virtual
```

```
User-Name = "000347e1bab9"
NAS-Port = 67
Acct-Status-Type = Start
Acct-Session-Id = "802.1x811219"
Called-Station-Id = "00-19-e2-50-52-60"
Calling-Station-Id = "00-03-47-e1-ba-b9"
Event-Timestamp = "Sep 10 2008 18:58:52 PDT"
NAS-Identifier = "esp48t-1b-01"
NAS-Port-Type = Virtual
```

**Related  
Documentation**

## Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode

IEEE 802.1X authentication provides network edge security, protecting Ethernet LANs from unauthorized user access by blocking all traffic to and from a supplicant (client) at the interface until the supplicant's credentials are presented and matched on the *authentication server* (a RADIUS server). When the supplicant is authenticated, the switch stops blocking access and opens the interface to the supplicant.



### NOTE:

- You can also specify an 802.1X exclusion list to specify supplicants that can bypass authentication and be automatically connected to the LAN.
- You cannot configure 802.1X user authentication on interfaces that have been enabled for Q-in-Q tunneling.
- You cannot configure 802.1X user authentication on redundant trunk groups (RTGs).

Before you begin, specify the RADIUS server or servers to be used as the authentication server.

To configure 802.1X on an interface:

1. Configure the supplicant mode as **single** (authenticates the first supplicant), **single-secure** (authenticates only one supplicant), or **multiple** (authenticates multiple supplicants):

```
[edit protocols authentication-access-control]
user@switch# set interface ge-0/0/5 supplicant multiple
```

2. Enable reauthentication and specify the reauthentication interval:

```
[edit protocols authentication-access-control]
user@switch# set interface ge-0/0/5 dot1x reauthentication interval 5
```

3. Configure the interface timeout value for the response from the supplicant:

```
[edit protocols authentication-access-control]
user@switch# set interface ge-0/0/5 dot1x supplicant-timeout 5
```

4. Configure the timeout for the interface before it resends an authentication request to the RADIUS server:

```
[edit protocols authentication-access-control]
user@switch# set interface ge-0/0/5 server-timeout 5
```

5. Configure how long, in seconds, the interface waits before retransmitting the initial EAPOL PDUs to the supplicant:

```
[edit protocols authentication-access-control]
user@switch# set interface ge-0/0/5 dot1x transmit-period 60
```

6. Configure the maximum number of times an EAPOL request packet is retransmitted to the supplicant before the authentication session times out:

```
[edit protocols authentication-access-control]
```

```
user@switch# set interface ge-0/0/5 dot1x maximum-requests 5
```

7. Configure the number of times the switch attempts to authenticate the port after an initial failure. The port remains in a wait state during the quiet period after the authentication attempt.

```
[edit protocols authentication-access-control]
```

```
user@switch# set interface ge-0/0/5 retries 1
```



**NOTE:** This setting specifies the number of tries before the switch puts the interface in a “HELD” state.

#### Related Documentation

## Configuring LLDP-MED on MX Series Routers in Enhanced LAN Mode

Link Layer Discovery Protocol–Media Endpoint Discovery (LLDP-MED) is an extension of LLDP. The router uses LLDP-MED to support device discovery of VoIP telephones and to create location databases for these telephone locations.

LLDP-MED is turned on by default on MX Series routers.

This topic describes:

- [Enabling LLDP-MED on Interfaces on page 51](#)
- [Configuring Location Information Advertised by the Router on page 51](#)
- [Configuring for Fast Start on page 52](#)

### Enabling LLDP-MED on Interfaces

LLDP-MED is enabled on all interfaces by default. If it is disabled, you can enable LLDP-MED by configuring it on all interfaces or on specific interfaces.

To configure LLDP-MED on all interfaces or on a specific interface:

```
[edit protocols lldp-med]
```

```
user@router# set interface (LLDP-MED) ge-0/0/2.0
```

### Configuring Location Information Advertised by the Router

You can configure the location information that is advertised from the router to the LLDP-MED device. You can specify a civic-based location (geographic location) or a location based on an ELIN (Emergency Location Identification Number):

- To specify a location by geography:

```
[edit protocols lldp-med]
```

```
user@router# set interface ge-0/0/2.0 location civic-based country-code US
```

```
user@router# set interface ge-0/0/2.0 location civic-based ca-type 1 ca-value "El Dorado County"
```

```
user@router# set interface ge-0/0/2.0 location civic-based ca-type 2 ca-value CA
```

```
user@router# set interface ge-0/0/2.0 location civic-based ca-type 3 ca-value Somerset
```

```
user@router# set interface ge-0/0/2.0 location civic-based ca-type 6 ca-value "Mount Aukum Road"
user@router# set interface ge-0/0/2.0 location civic-based ca-type 19 ca-value 6450
user@router# set interface ge-0/0/2.0 location civic-based ca-type 21 ca-value "Holiday Market"
```

- To specify a location using an elin string:

```
[edit protocols lldp-med]
user@router# set interface ge-0/0/2.0 location elin 4085551212
```

## Configuring for Fast Start

You can specify the number of LLDP-MED advertisements sent from the router in the first second after it has detected an LLDP-MED device. The default is 3; to set it to another value:

```
[edit protocols lldp-med]
user@router# set fast-start 6
```



**NOTE:** If an interface is configured as a VoIP interface, then the router does not wait for an attached phone to identify itself as an LLDP-MED device before it performs an LLDP-MED fast start after a graceful Routing Engine switchover (GRES) or a reboot. Instead, it immediately performs an LLDP-MED fast start after a GRES or reboot. This behavior prevents certain models of IP phones from resetting after a GRES.

### Related Documentation

## Configuring LLDP on MX Series Routers in Enhanced LAN Mode

---

Devices use Link Layer Discovery Protocol (LLDP) and Link Layer Discovery Protocol–Media Endpoint Discovery (LLDP-MED) to learn and distribute device information on network links. The information enables the device to quickly identify a variety of other devices, resulting in a LAN that interoperates smoothly and efficiently.

This topic describes:

- [Enabling LLDP on Interfaces on page 52](#)
- [Adjusting LLDP Advertisement Settings on page 53](#)
- [Adjusting SNMP Notification Settings of LLDP Changes on page 54](#)
- [Specifying a Management Address for the LLDP Management TLV on page 54](#)

## Enabling LLDP on Interfaces

LLDP is enabled on all interfaces by default. If it is disabled, you can enable LLDP by configuring it on all interfaces or on specific interfaces.

- To configure LLDP on all interfaces:

```
[edit protocols lldp]
user@router# set interface all
```



- To configure LLDP on a specific interface:

```
[edit protocols lldp]
user@router# set interface interface-name
```



**NOTE:** On MX Series routers, LLDP cannot be configured on the management Ethernet interface. Issuing the command `set protocols lldp interfaceem0` generates the following error message:

```
error: name: 'em0': Invalid interface
error: statement creation failed: interface
```

## Adjusting LLDP Advertisement Settings

You can adjust the following settings for LLDP advertisements for troubleshooting or verification purposes. The default values are applied when LLDP is enabled. For normal operations, we recommend that you do not change the default values.

- To specify the frequency at which LLDP advertisements are sent (in seconds):

```
[edit protocols lldp]
user@router# set advertisement-interval seconds
```

For example, using the default value:

```
[edit protocols lldp]
user@router# set advertisement-interval 45
```

- To specify the number of seconds that LLDP information is held before it is discarded (the multiplier value is used in combination with the **advertisement-interval** value):

```
[edit protocols lldp]
user@router# set hold-multiplier seconds
```

For example, using the default value:

```
[edit protocols lldp]
user@router# set hold-multiplier 5
```

- To specify the number of seconds the device delays before sending advertisements to neighbors after a change is made in a TLV (type, length, or value) element in LLDP or in the state of the local system, such as a change in hostname or management address, set the transmit delay. The transmit delay is enabled by default on switches to reduce the delay in notifying neighbors of a change in the local system. The default value is 2 seconds (if the **advertisement-interval** value is set to 8 seconds or more) or 1 second (if the **advertisement-interval** value is set to less than 8 seconds).

```
[edit protocols lldp]
user@router# set transmit-delay seconds
```

For example:

```
[edit protocols lldp]
user@router# set transmit-delay 2
```



**NOTE:** The **advertisement-interval** value must be greater than or equal to four times the **transmit-delay** value; otherwise, an error is returned when you attempt to commit the configuration.

## Adjusting SNMP Notification Settings of LLDP Changes

You can adjust the following settings for SNMP notifications of LLDP changes. If the values are not specified or if the interval values are set to **0**, the notifications are disabled.

- To specify the frequency at which LLDP database changes are sent (in seconds):

```
[edit protocols lldp]
user@router# set lldp-configuration-notification-interval seconds
```

For example:

```
[edit protocols lldp]
user@router# set lldp-configuration-notification-interval 600
```

- To configure the time interval for SNMP trap notifications to wait for topology changes (in seconds):

```
[edit protocols lldp]
user@router# set ptopo-configuration-trap-interval seconds
```

For example:

```
[edit protocols lldp]
user@router# set ptopo-configuration-trap-interval 600
```

- To specify the holding time (used in combination with the **ptopo-configuration-trap-interval** value) to maintain dynamic topology entries (in seconds):

```
[edit protocols lldp]
user@router# set ptopo-configuration-maximum-hold-time seconds
```

For example:

```
[edit protocols lldp]
user@router# set ptopo-configuration-maximum-hold-time 2147483647
```

## Specifying a Management Address for the LLDP Management TLV

You can configure an IPv4 or IPv6 management address to be used in the LLDP Management Address type, length, and value (TLV) messages. Only out-of-band management addresses must be used as the value for the **management-address** statement.

To configure the management address:

```
[edit protocols lldp]
user@router# set management-address ip-address
```



**NOTE:** Ensure that the interface with the configured management address has LLDP enabled using the `set protocols lldp interface` command. If you configure a customized management address for LLDP on an interface that has LLDP disabled, the `show lldp local-information` command output will not display the correct interface information.

---

## Configuring Server Fail Fallback on MX Series Routers in Enhanced LAN Mode

---

Server fail fallback allows you to specify how end devices connected to the router are supported if the RADIUS authentication server becomes unavailable or sends a RADIUS access-reject message.

802.1X and MAC RADIUS authentication work by using an *authenticator port access entity* (the router) to block all traffic to and from an end device at the interface until the end device's credentials are presented and matched on the *authentication server* (a RADIUS server). When the end device has been authenticated, the router stops blocking and opens the interface to the end device.

When you set up 802.1X or MAC RADIUS authentication on the router, you specify a primary authentication server and one or more backup authentication servers. If the primary authentication server cannot be reached by the router and the secondary authentication servers are also unreachable, a RADIUS server timeout occurs. Because the authentication server grants or denies access to the end devices awaiting authentication, the router does not receive access instructions for end devices attempting access to the LAN and normal authentication cannot be completed. Server fail fallback allows you to configure authentication alternatives that permit the router to take appropriate actions toward end devices awaiting authentication or reauthentication.



**NOTE:** The authentication fallback method called *server-reject VLAN* provides limited access to a LAN, typically just to the Internet, for responsive end devices that are 802.1X-enabled but that have sent the wrong credentials. If the end device that is authenticated using the server-reject VLAN is an IP phone, voice traffic is not allowed.

---

To configure basic server fail fallback options using the CLI:

- Configure an interface to allow traffic to flow from a supplicant to the LAN if a RADIUS server timeout occurs (as if the end device had been successfully authenticated by a RADIUS server):

```
[edit protocols authentication-access-control]  
user@router# set interface ge-0/0/1 dot1x server-fail permit
```

- Configure an interface to prevent traffic flow from an end device to the LAN (as if the end device had failed authentication and had been rejected by the RADIUS server):

```
[edit protocols authentication-access-control]  
user@router# set interface ge-0/0/1 dot1x server-fail deny
```

- Configure an interface to move an end device to a specified VLAN if a RADIUS server timeout occurs (in this case, the VLAN name is `vlan1`):

```
[edit protocols authentication-access-control]  
user@router# set interface ge-0/0/1 dot1x server-fail vlan-name vlan1
```

- Configure an interface to recognize already connected end devices as reauthenticated if there is a RADIUS timeout during reauthentication (new users will be denied access):

```
[edit protocols authentication-access-control]  
user@router# set interface ge-0/0/1 dot1x server-fail use-cache
```

- Configure an interface that receives a RADIUS access-reject message from the authentication server to move end devices attempting LAN access on the interface to a specified VLAN already configured on the router (in this case, the VLAN name is `vlan-sf`):

```
[edit protocols authentication-access-control]  
user@router# set interface ge-0/0/1 dot1x server-reject-vlan vlan-sf
```



**NOTE:** If an IP phone is authenticated in the server-reject VLAN, voice traffic is not allowed.

---

## Understanding Captive Portal Authentication on the MX Series Routers

---

Captive portal authentication (hereafter referred to as captive portal) allows you to authenticate users on MX Series routers by redirecting Web browser requests to a login page that requires users to input a username and password before they are allowed access to the network. Captive portal controls network access by requiring users to provide information that is authenticated against a RADIUS server database using EAP-MD5. You can also use captive portal to display an acceptable-use policy to users before they access your network.

Juniper Networks Junos Software for MX Series routers provides a template that allows you to easily design and modify the look of the captive portal login page. You enable specific interfaces for captive portal. The first time a client connected to a captive portal interface attempts to access a webpage, the switch presents the captive portal login page. Upon successful authentication, the user is allowed access to the network and to continue to the original page requested.



**NOTE:** If Hypertext Transfer Protocol Secure (HTTPS) is enabled, Hypertext Transfer Protocol (HTTP) requests are redirected to an HTTPS connection for the captive portal authentication process. After authentication, the client is returned to the HTTP connection.

If there are clients that are not HTTP-enabled connected to the captive portal interface, you can allow them to bypass captive portal authentication by adding their MAC address to an authentication whitelist. (If the MAC address has already been learned on the interface, you must clear it using the **clear captive-portal interface *interface-name*** before adding it to the whitelist.)

When the user is authenticated by the RADIUS server, any per-user policies (attributes) associated with that user are also sent to the switch.

## Limitations of Captive Portal

Captive portal on MX Series routers has the following limitations:

- The captive portal interface must be configured for **family ethernet-switching** and set to port mode access. The VLAN must be configured with a routed VLAN interface (RVI).
- The DHCP gateway IP address for the switch must be configured as the IP address of the routed VLAN interface.
- Captive portal does not support dynamic assignment of VLANs downloaded from the RADIUS server.
- If the user is idle for more than about 5 minutes and there is no traffic passed, the user is required to log back in to the captive portal.

## Understanding Authentication Session Timeout on MX Series Routers

You can specify authentication session timeout values for captive portal authentication sessions and 802.1X and MAC RADIUS authentication sessions.

For captive portal authentication, the length of the session depends on the value configured for the **session-expiry** statement. The remainder of this topic pertains only to 802.1X and MAC RADIUS authentication sessions.

For 802.1X and MAC RADIUS authentication sessions, the timeout of the session depends on the value of **reauthentication interval** for **dot1x authentication**. The authentication session might also end when the MAC table aging time expires because, unless you configure it not to, the session is removed from the authentication session table when the MAC address is removed from the Ethernet switching table.

Information about each 802.1X and MAC RADIUS authentication session—including the associated interfaces and VLANs for each MAC address that is authenticated by 802.1X authentication or MAC RADIUS authentication—is stored in the authentication session table. The authentication session table is tied to the Ethernet switching table (also called the MAC table). Each time the switch detects traffic from a MAC address, it updates the

timestamp for that network node in the Ethernet switching table. A timer on the switch periodically checks the timestamp and if its value exceeds the user-configured **mac-table-aging-time** value, the switch removes the MAC address from the Ethernet switching table. When a MAC address ages out of the Ethernet switching table, the entry for that MAC address is also removed from the authentication database, with the result that the session ends.

You can control variables affecting timeout of authentication sessions in the following ways:

- Set the authentication session timeout on all interfaces or on selected interfaces using the **reauthentication** statement.
- Disassociate the authentication session table from the Ethernet switching table using the **no-mac-table-binding** statement. This setting prevents the termination of the authentication session when the associated MAC address ages out of the Ethernet switching table.

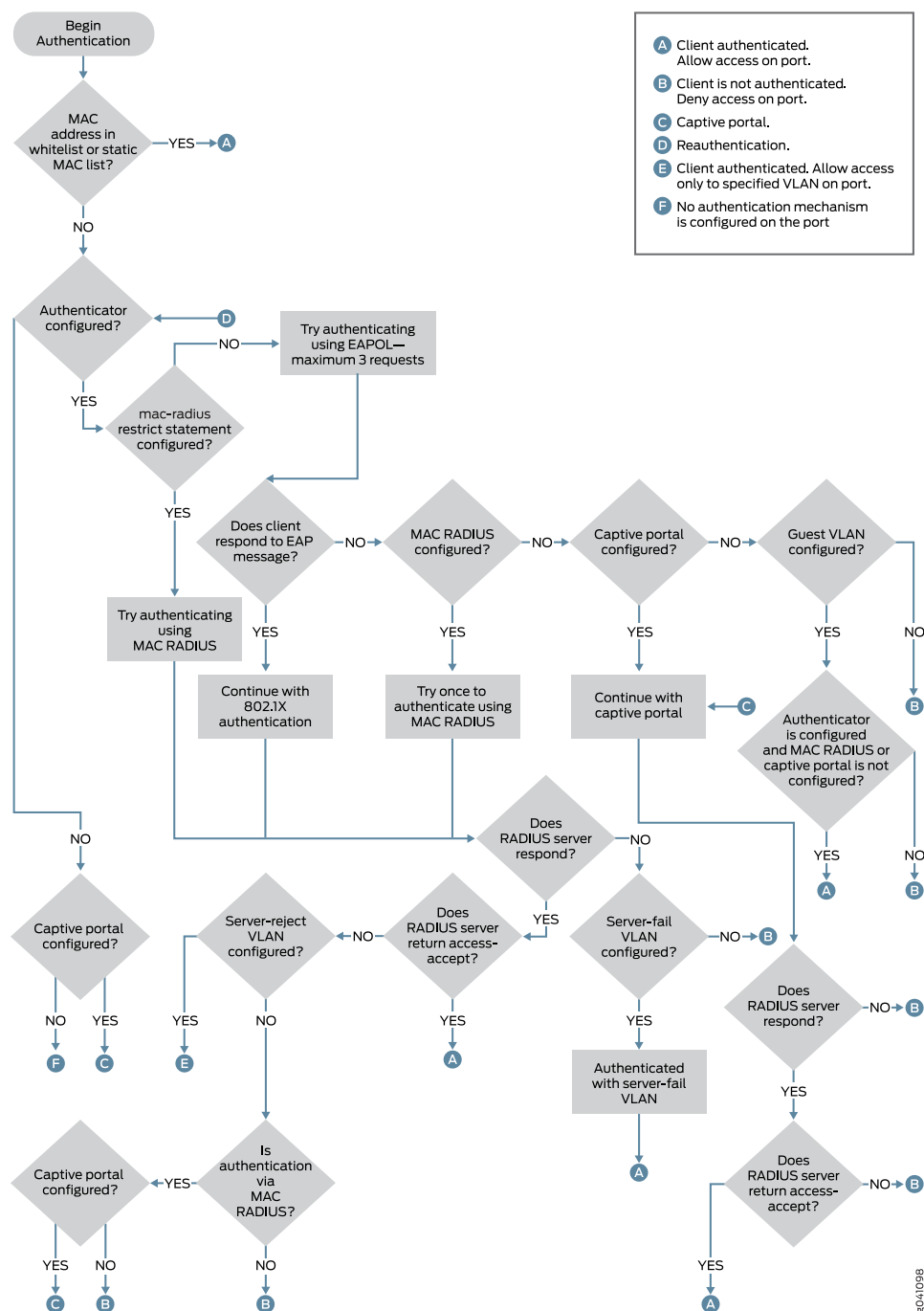
---

## Authentication Process Flow for MX Series Routers in Enhanced LAN Mode

You can control access to your network through an MX Series router by using several different authentication methods—including 802.1X, MAC RADIUS, or captive portal.

[Figure 3 on page 59](#) illustrates the authentication process:

Figure 3: Authentication Process Flow for an MX Series Router



## Specifying RADIUS Server Connections on an MX Series Router in Enhanced LAN Mode

IEEE 802.1X and MAC RADIUS authentication both provide network edge security, protecting Ethernet LANs from unauthorized user access by blocking all traffic to and from devices at the interface until the supplicant's credentials or MAC address are presented and matched on the *authentication server* (a RADIUS server). When the supplicant is authenticated, the router stops blocking access and opens the interface to the supplicant.

To use 802.1X or MAC RADIUS authentication, you must specify the connections on the router for each RADIUS server to which you will connect.

To configure a RADIUS server on the router:

1. Define the IP address of the RADIUS server, the RADIUS server authentication port number, and the secret password. You can define more than one RADIUS server. The secret password on the router must match the secret password on the server:

```
[edit access]
user@router# set radius-server 10.0.0.100 port 1812 secret abc
```



**NOTE:** Specifying the authentication port is optional, and port 1812 is the default. However, we recommend that you configure it in order to avoid confusion as some RADIUS servers might refer to an older default.

2. (Optional) Specify the IP address by which the router is identified by the RADIUS server. If you do not specify this, the RADIUS server uses the address of the interface sending the RADIUS request. We recommend that you specify this IP address because if the request gets diverted on an alternate route to the RADIUS server, the interface relaying the request might not be an interface on the router.

```
[edit access]
user@router# set radius-server source-address 10.93.14.100
```

3. Configure the authentication order, making **radius** the first method of authentication:

```
[edit access]
user@router# set profile profile1 authentication-order radius
```

4. Create a profile and specify the list of RADIUS servers to be associated with the profile. For example, you might choose to group your RADIUS servers geographically by city. This feature enables easy modification whenever you want to change to a different set of authentication servers.

```
[edit access profile]
user@router# set atlanta radius authentication-server 10.0.0.100 10.2.14.200
```

5. Specify the group of servers to be used for 802.1X or MAC RADIUS authentication by identifying the profile name:

```
[edit access profile]
user@router# set protocols authentication-access-control authentication-profile-name
denver
```



6. Configure the IP address of the MX Series router in the list of clients on the RADIUS server. For specifics on configuring the RADIUS server, consult the documentation for your server.

## Configuring Captive Portal Authentication on MX Series Routers in Enhanced LAN Mode



**NOTE:** This example uses Junos OS for MX240, MX480, and MX960 routers with support for the Enhanced LAN mode configuration style. If your router does not run MX-LAN mode, you cannot configure port-based authentication settings in the same manner as described in this section. If you remove the `network-services lan` statement at the `[edit chassis]` hierarchy level, the system does not run in MX-LAN mode. Therefore, all of the settings that are supported outside of the MX-LAN mode are displayed and are available for definition in the CLI interface. In such a scenario, you must use the statements at the `[edit protocols dot1x]` hierarchy level to configure 802.1x and MAC RADIUS authentication, and the options at the `[edit services captive-portal]` hierarchy level to configure captive portal authentication. In MX-LAN mode, you can configure all the port-based network access control methodologies using the statements at the `[edit protocols authentication-access-control]` hierarchy level.

Configure captive portal authentication (hereafter referred to as captive portal) on an MX Series router so that users connected to the router are authenticated before being allowed to access the network. When the user requests a webpage, a login page is displayed that requires the user to input a username and password. Upon successful authentication, the user is allowed to continue with the original page request and subsequent access to the network.

Before you begin, be sure you have:

- Performed basic bridging and VLAN configuration on the router.
- Generated an SSL certificate and installed it on the router.
- Configured basic access between the MX Series router and the RADIUS server.
- Designed your captive portal login page.

This topic includes the following tasks:

- [Configuring Secure Access for Captive Portal on page 61](#)
- [Enabling an Interface for Captive Portal on page 62](#)
- [Configuring Bypass of Captive Portal Authentication on page 62](#)

### Configuring Secure Access for Captive Portal

To configure secure access for captive portal:

1. Associate the security certificate with the Web server and enable HTTPS on the router:

```
[edit]
user@router# set system services web-management https local-certificate my-signed-cert
```



**NOTE:** You can enable HTTP instead of HTTPS, but we recommend HTTPS for security purposes.

2. Configure captive portal to use HTTPS:

```
[edit]
user@router# set protocols custom-options-captive-portal secure-authentication https
```

## Enabling an Interface for Captive Portal

To enable an interface for use with captive portal authentication:

```
[edit]
user@router# set authentication-access-control interface ge-0/0/10
```

## Configuring Bypass of Captive Portal Authentication

You can allow specific clients to bypass captive portal authentication:

```
[edit]
user@router# set authentication-access-control static 00:10:12:e0:28:22
```



**NOTE:** Optionally, you can use `set authentication-access-control static 00:10:12:e0:28:22 interface ge-0/0/10.0` to limit the scope to the interface.



**NOTE:** If the client is already attached to the router, you must clear its MAC address from the captive portal authentication by using the `clear captive-portal mac-address session-mac-addr` command after adding its MAC address to the whitelist. Otherwise the new entry for the MAC address will not be added to the Ethernet switching table and the authentication bypass will not be allowed.

## Designing a Captive Portal Authentication Login Page on an MX Series Router

You can set up captive portal authentication on your switch to redirect all Web browser requests to a login page that requires the user to input a username and password before they are allowed access. Upon successful authentication, the user is allowed access to the network and redirected to the original page requested.

Junos OS provides a customizable template for the captive portal window that allows you to easily design and modify the look of the captive portal login page. You can modify the design elements of the template to change the look of your captive portal login page and to add instructions or information to the page. You can also modify any of the design elements of a captive portal login page.

The first screen displayed before the captive login page requires the user to read the “Terms and Conditions of Use”. By clicking the Agree button, the user can access the captive portal login page.

Figure 4 on page 63 shows an example of a captive portal login page:

Figure 4: Example of a Captive Portal Login Page

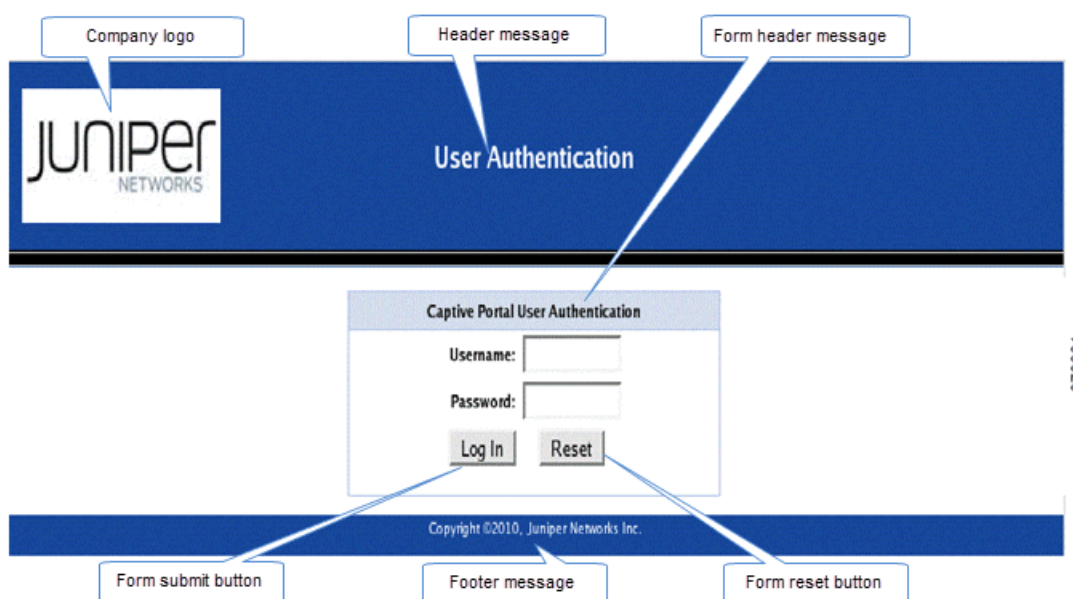


Table 3 on page 63 summarizes the configurable elements of a captive portal login page.

Table 3: Configurable Elements of a Captive Portal Login Page

Element	CLI Statement	Description
Footer background color	<b>footer-bgcolor</b> <i>hex-color</i>	The HTML hexadecimal code for the background color of the captive portal login page footer.

Table 3: Configurable Elements of a Captive Portal Login Page (*continued*)

Element	CLI Statement	Description
Footer message	<b>footer-message</b> <i>text-string</i>	Text displayed in the footer of the captive portal login page. You can include copyright information, links, and additional information such as help instructions, legal notices, or a privacy policy  The default text shown in the footer is <b>Copyright ©2010, Juniper Networks Inc.</b>
Footer text color	<b>footer- text-color</b> <i>color</i>	Color of the text in the footer. The default color is white.
Form header background color	<b>form-header-bgcolor</b> <i>hex-color</i>	The HTML hexadecimal code for the background color of the header bar across the top of the form area of the captive portal login page.
Form header message	<b>form-header-message</b> <i>text-string</i>	Text displayed in the header of the captive portal login page. The default text is <b>Captive Portal User Authentication</b>
Form header text color	<b>form-header- text- color</b> <i>color</i>	Color of the text in the form header. The default color is black.
Form reset button label	<b>form-reset-label</b> <i>label-name</i>	Using the <b>Reset</b> button, the user can clear the username and password fields on the form.
Form submit button label	<b>form-submit-label</b> <i>label-name</i>	Using the <b>Login</b> button, the user can submit the login information.
Header background color	<b>header-bgcolor</b> <i>hex-color</i>	The HTML hexadecimal code for the background color of the captive portal login page header.
Header logo	<b>header-logo</b> <i>filename</i>	Filename of the file containing the image of the logo that you want to appear in the header of the captive portal login page. The image file can be in GIF, JPEG, or PNG format  You can upload a logo image file to the switch. Copy the logo to the /var/tmp directory on the switch (during commit, the files are saved to persistent locations).  If you do not specify a logo image, the Juniper Networks logo is displayed.
Header message	<b>header-message</b> <i>text-string</i>	Text displayed in the page header. The default text is <b>User Authentication</b> .
Header text color	<b>header-text- color</b> <i>color</i>	Color of the text in the header. The default color is white.
Post-authentication URL	<b>post-authentication-url</b> <i>url</i>	URL to which the users are directed on successful authentication. By default, users are directed to the page they had originally requested.

To design the captive portal login page:

- (Optional) Upload your logo image file to the switch:  

```
user@router> file copy ftp://username:prompt@ftp.hostname.net/var/tmp/my-logo.jpeg
```
- Configure the custom options to specify the background colors and text displayed in the captive portal page:

```
[edit protocols]
user@router# set captive-portal-custom-options header-bgcolor #006600
set captive-portal-custom-options header-message "Welcome to Our Network"
set captive-portal-custom-options banner-message "Please enter your username and
password".The banner displays the message "XXXXXXX" by default. The user can modify this
message.
set custom-options footer-message "Copyright ©2010, Our Network"
```

Now you can commit the configuration.



**NOTE:** For the custom options that you do not specify, the default value is used.

## Configuring Static MAC Bypass of Authentication on MX Series Routers in Enhanced LAN Mode

You can configure a static MAC bypass list (sometimes called the exclusion list) on the switch to specify MAC addresses of devices allowed access to the LAN without 802.1X or MAC RADIUS authentication requests to the RADIUS server.

To configure the static MAC bypass list:

- Specify a MAC address to bypass authentication:

```
[edit protocols authentication-access-control]
user@router# set static 00:04:0f:fd:ac:fe
```

- Configure a supplicant to bypass authentication if connected through a particular interface:

```
[edit protocols authentication-access-control]
user@router# set static 00:04:0f:fd:ac:fe interface ge-0/0/5
```

- You can configure a supplicant to be moved to a specific VLAN after it is authenticated:

```
[edit protocols authentication-access-control]
user@router# set static 00:04:0f:fd:ac:fe interface ge-0/0/5 vlan-assignment default-vlan
```

## Controlling Authentication Session Timeouts on an MX Series Router in Enhanced LAN Mode

For 802.1X and MAC RADIUS authentication sessions, you can specify authentication session timeout values using the **reauthentication** statement.

The session might also end when the MAC table aging time expires, because the session is removed from the authentication session table when the MAC address is removed from the Ethernet switching table. In order to prevent the session from being removed from the authentication session table, you must disassociate the authentication table from the Ethernet switching table using the **no-mac-table-binding** statement.

Before you begin:

- Specify the RADIUS server or servers to be used as the authentication server.
- Configure 802.1X authentication on the router.

To configure the authentication session time on all interfaces:

```
[edit]
user@router# set protocols authentication-access-control interface all dot1x reauthentication
seconds;
```

To configure the authentication session time on a single interface:

```
[edit]
user@router# set protocols authentication-access-control interface interface-name dot1x
reauthentication seconds;
```

To disable removal of authentication sessions from the authentication session table when a MAC address ages out of the Ethernet switching table, remove the binding of the authentication table to the Ethernet switching table.

To remove the binding on all interfaces:

```
[edit]
user@router# set protocols authentication-access-control no-mac-table-binding interface all;
```

To remove the binding on a single interface:

```
[edit]
user@router# set protocols authentication-access-control no-mac-table-binding interface
interface-name;
```

**Related  
Documentation**

## Configuring MAC RADIUS Authentication on MX Series Routers in Enhanced LAN Mode

You can permit devices that are not 802.1X-enabled LAN access by configuring MAC RADIUS authentication on the MX Series router interfaces to which the hosts are connected.



**NOTE:** You can also allow non-802.1X-enabled devices to access the LAN by configuring their MAC address for static MAC bypass of authentication.

You can configure MAC RADIUS authentication on an interface that also allows 802.1X authentication, or you can configure either authentication method alone.

If both MAC RADIUS and 802.1X authentication are enabled on the interface, the router first sends the host three EAPOL requests to the host. If there is no response from the host, the router sends the host's MAC address to the RADIUS server to check whether it is a permitted MAC address. If the MAC address is configured as permitted on the RADIUS server, the RADIUS server sends a message to the router that the MAC address is a permitted address, and the router opens LAN access to the nonresponsive host on the interface to which it is connected.

If MAC RADIUS authentication is configured on the interface but 802.1X authentication is not (by using the **mac-radius restrict** option), the router attempts to authenticate the MAC address with the RADIUS server without delaying by attempting 802.1X authentication first.

Before you configure MAC RADIUS authentication, be sure you have:

- Configured basic access between the MX Series router and the RADIUS server.
- Configured MX240, MX480, and MX960 routers to function in enhanced LAN mode by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level.

To configure MAC RADIUS authentication using the CLI:

- On the router, configure the interfaces to which the nonresponsive hosts are attached for MAC RADIUS authentication, and add the **restrict** qualifier for interface **ge-0/0/20** to have it use only MAC RADIUS authentication:

```
[edit]
user@router# set protocols authentication-access-control interface ge-0/0/19 dot1x
mac-radius
user@router# set protocols authentication-access-control interface ge-0/0/20 dot1x
mac-radius restrict
```

- On a RADIUS authentication server, create user profiles for each nonresponsive host using the MAC address (without colons) of the nonresponsive host as the username and password (here, the MAC addresses are **00:04:0f:fd:ac:fe** and **00:04:ae:cd:23:5f**):

```
[root@freeradius]#
edit /etc/raddb
vi users
00040ffdacfe Auth-type:=Local, User-Password = "00040ffdacfe"
0004aecd235f Auth-type:=Local, User-Password = "0004aecd235f"
```

Related  
Documentation

---

## Example: Configuring MAC RADIUS Authentication on an MX Series Router

---

To permit hosts that are not 802.1X-enabled to access the LAN, you can configure MAC RADIUS authentication on the router interfaces to which the non-802.1X-enabled hosts are connected. When MAC RADIUS authentication is configured, the router will attempt to authenticate the host with the RADIUS server using the host's MAC address.

This example describes how to configure MAC RADIUS authentication for two non-802.1X-enabled hosts:

- [Requirements on page 68](#)
- [Overview and Topology on page 69](#)
- [Configuration on page 70](#)
- [Verification on page 71](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.2 or later for MX240, MX480, or MX960 routers running in enhanced LAN mode.
- An MX Series router acting as an authenticator port access entity (PAE). The ports on the authenticator PAE form a control gate that blocks all traffic to and from supplicants until they are authenticated.
- A RADIUS authentication server. The authentication server acts as the backend database and contains credential information for hosts (supplicants) that have permission to connect to the network.



Before you connect the server to the router, be sure you have:

- Configured enhanced LAN mode on the router.
- Performed basic bridging and VLAN configuration on the router.
- Configured users on the RADIUS authentication server.

## Overview and Topology

IEEE 802.1X Port-Based Network Access Control (PNAC) authenticates and permits devices access to a LAN if the devices can communicate with the router using the 802.1X protocol (are 802.1X-enabled). To permit non-802.1X-enabled end devices to access the LAN, you can configure MAC RADIUS authentication on the interfaces to which the end devices are connected. When the MAC address of the end device appears on the interface, the router consults the RADIUS server to check whether it is a permitted MAC address. If the MAC address of the end device is configured as permitted on the RADIUS server, the router opens LAN access to the end device.

You can configure both MAC RADIUS authentication and 802.1X authentication methods on an interface configured for multiple supplicants. Additionally, if an interface is only connected to a non-802.1X-enabled host, you can enable MAC RADIUS and not enable 802.1X authentication using the **mac-radius restrict** option, and thus avoid the delay that occurs while the router determines that the device does not respond to EAP messages.

Two printers are connected to an MX Series router over interfaces, ge-0/0/19 and ge-0/0/20.

[Table 4 on page 69](#) shows the components in the example for MAC RADIUS authentication.

**Table 4: Components of the MAC RADIUS Authentication Configuration Topology**

Property	Settings
Router hardware	Ports (ge-0/0/0 through ge-0/0/23)
VLAN name	sales
Connections to printers	ge-0/0/19, MAC address 00040ffdacfe ge-0/0/20, MAC address 0004aec235f
RADIUS server	Connected to the router on interface <b>ge-0/0/10</b>

The printer with the MAC address 00040ffdacfe is connected to access interface ge-0/0/19. A second printer with the MAC address 0004aec235f is connected to access interface ge-0/0/20. In this example, both interfaces are configured for MAC RADIUS authentication on the router, and the MAC addresses (without colons) of both printers are configured on the RADIUS server. Interface ge-0/0/20 is configured to eliminate the normal delay while the router attempts 802.1X authentication; MAC RADIUS authentication is enabled and 802.1X authentication is disabled using the **mac radius restrict** option.

## Configuration

**CLI Quick Configuration** To quickly configure MAC RADIUS authentication, copy the following commands and paste them into the router terminal window:

```
[edit]
set protocols authentication-access-control interface ge-0/0/19 dot1x mac-radius
set protocols authentication-access-control authenticator interface ge-0/0/20 dot1x mac-radius restrict
```



**NOTE:** You must also configure the two MAC addresses as usernames and passwords on the RADIUS server, as is done in step 2 of the Step-by-Step Procedure.

**Step-by-Step Procedure** Configure MAC RADIUS authentication on the router and on the RADIUS server:

1. On the router, configure the interfaces to which the printers are attached for MAC RADIUS authentication, and configure the **restrict** option on interface **ge-0/0/20**, so that only MAC RADIUS authentication is used:
 

```
[edit]
user@router# set protocols authentication-access-control interface ge-0/0/19 dot1x mac-radius
user@router# set protocols authentication-access-control authenticator interface ge-0/0/20 dot1x mac-radius restrict
```
2. On the RADIUS server, configure the MAC addresses **00040ffdacfe** and **0004aec235f** as usernames and passwords:
 

```
[root@freeradius]#
edit /etc/raddb
vi users
00040ffdacfe Auth-type:=EAP, User-Password = "00040ffdacfe"
0004aec235f Auth-type:=EAP, User-Password = "0004aec235f"
```

**Results** Display the results of the configuration on the router:

```
user@router> show configuration
protocols {
  authentication-access-control {
    authentication-profile-name profile52;
    interface {
      ge-0/0/19.0 {
        dot1x {
          mac-radius;
        }
      }
      ge-0/0/20.0 {
        dot1x {
          mac-radius {
            restrict;
          }
        }
      }
    }
  }
}
```

```
}  
}  
}
```

## Verification

Verify that the supplicants are authenticated:

- [Verifying That the Supplicants Are Authenticated on page 71](#)

### Verifying That the Supplicants Are Authenticated

**Purpose** After supplicants are configured for MAC RADIUS authentication on the router and on the RADIUS server, verify that they are authenticated and display the method of authentication:

**Action** Display information about 802.1X-configured interfaces **ge-0/0/19** and **ge-0/0/20**:

```
user@router> show dot1x interface ge-0/0/19.0 detail
ge-0/0/19.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Single
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Disabled
  Reauthentication: Enabled
  Configured Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: <not configured>
  Number of connected supplicants: 1
    Supplicant: user101, 00:04:0f:fd:ac:fe
      Operational state: Authenticated
      Authentication method: Radius
      Authenticated VLAN: vo11
      Dynamic Filter: match source-dot1q-tag 10 action deny
      Session Reauth interval: 60 seconds
      Reauthentication due in 50 seconds

user@router> show dot1x interface ge-0/0/20.0 detail
ge-0/0/20.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Single
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Enabled
  Reauthentication: Enabled
  Configured Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: <not configured>
  Number of connected supplicants: 1
    Supplicant: user102, 00:04:ae:cd:23:5f
      Operational state: Authenticated
      Authentication method: Radius
      Authenticated VLAN: vo11
      Dynamic Filter: match source-dot1q-tag 10 action deny
      Session Reauth interval: 60 seconds
      Reauthentication due in 50 seconds
```

**Meaning** The sample output from the **show dot1x interface detail** command displays the MAC address of the connected end device in the **Supplicant** field. On interface **ge-0/0/19**, the MAC address is **00:04:0f:fd:ac:fe**, which is the MAC address of the first printer configured for MAC RADIUS authentication. The **Authentication method** field displays the authentication method as **MAC Radius**. On interface **ge-0/0/20**, the MAC address is **00:04:ae:cd:23:5f**, which is the MAC address of the second printer configured for MAC

RADIUS authentication. The **Authentication method** field displays the authentication method as **MAC Radius**.

## Example: Setting Up Captive Portal Authentication on an MX Series Router

---

You can set up captive portal authentication (hereafter referred to as captive portal) on a router to redirect Web browser requests to a login page that requires the user to input a username and password. Upon successful authentication, the user is allowed to continue with the original page request and subsequent access to the network.

This example describes how to set up captive portal on an MX Series router:

- [Requirements on page 73](#)
- [Overview and Topology on page 73](#)
- [Configuration on page 73](#)
- [Verification on page 76](#)
- [Troubleshooting on page 76](#)

### Requirements

This example uses the following hardware and software components:

- An MX Series router that supports captive portal
- Junos OS Release 14.2 or later for MX Series routers

Before you begin, be sure you have:

- Performed basic bridging and VLAN configuration on the router.
- Generated an SSL certificate and installed it on the router.
- Configured basic access between the MX Series router and the RADIUS server.
- Designed your captive portal login page. .

### Overview and Topology

This example shows the configuration required on the router to enable captive portal on an interface. To permit a printer connected to the captive portal interface to access the LAN without going through captive portal, add its MAC address to the authentication whitelist. The MAC addresses in this list are permitted access on the interface without captive portal.

The topology for this example consists of one MX Series router connected to a RADIUS authentication server. One interface on the router is configured for captive portal. In this example, the interface is configured in multiple supplicant mode.

### Configuration

To configure captive portal on your router:

**CLI Quick Configuration** To quickly configure captive portal on the router after completing the tasks in the Requirements section, copy the following commands and paste them into the router terminal window:

```
[edit]
set system services web-management http
set system services web-management https local-certificate my-signed-cert
set protocols captive-portal-custom-options secure-authentication https
set protocols authentication-access-control interface ge-0/0/10.0 supplicant multiple
set protocols authentication-access-control static 00:10:12:e0:28:22
set protocols captive-portal-custom-options post-authentication-url
http://www.my-home-page.com
```

**Step-by-Step Procedure** To configure captive portal on the router:

1. Enable HTTP access on the router:

```
[edit]
user@router# set system services web-management http
```

2. To create a secure channel for Web access to the router, configure captive portal for HTTPS:



**NOTE:** You can enable HTTP without enabling HTTPS, but we recommend HTTPS for security purposes.

- a. Associate the security certificate with the Web server and enable HTTPS access on the router:

```
[edit]
user@router# set system services web-management https local-certificate
my-signed-cert
```

- b. Configure captive portal to use HTTPS:

```
[edit]
user@router# set protocols captive-portal-custom-options secure-authentication
https
```

3. Enable an interface for captive portal:

```
[edit]
user@router# set protocols authentication-access-control interface ge-0/0/10.0 supplicant
multiple
```

4. (Optional) Allow specific clients to bypass captive portal:



**NOTE:** If the client is already attached to the router, you must clear its MAC address from the captive portal authentication by using the `clear captive-portal mac-address mac-address` command after adding its MAC address to the whitelist. Otherwise the new entry for the MAC address will not be added to the Ethernet routing table and authentication bypass will not be allowed.

```
[edit]
user@router# set protocols authentication-access-control static 00:10:12:e0:28:22
```



**NOTE:** Optionally, you can use `set ethernet-switching-options authentication-whitelist 00:10:12:e0:28:22 interface ge-0/0/10.0` to limit the scope to the interface.

5. (Optional) To redirect clients to a specified page rather than the page they originally requested, configure the post-authentication URL:

```
[edit services captive-portal]
user@router# set protocols captive-portal-custom-options post-authentication-url
http://www.my-home-page.com
```

**Results** Display the results of the configuration:

```
[edit]
user@router> show
system {
  services {
    web-management {
      http;
      https {
        local-certificate my-signed-cert;
      }
    }
  }
}
security {
  certificates {
    local {
      my-signed-cert {
        "-----BEGIN RSA PRIVATE KEY-----\nMIICXwIBAAKBgQDk8sUggnXdDUmr7T
vLv63yJq/LRpDASfIDZlX3z9ZDeIKfk5C9\nr/tkyvzv
...
Pt5YmvWDoGo0mSjoE/liH0BqYdh9YGqv3T2IEUfflSTQQHEOSHS0ogWDHF\
nnyObIO/vQtjk20X9NVQg JHBwidssY9eRp\n-----END CERTIFICATE-----\n";
        ## SECRET-DATA
      }
    }
  }
}
protocols {
  authentication-access-control {
    static 00:10:12:e0:28:22/48;
    interface {
      ge-0/0/10.0 {
        supplicant multiple;
      }
    }
  }
  custom-captive-portal-options {
    secure-authentication https;
    post-authentication-url http://www.my-home-page.com;
  }
}
```

## Verification

To confirm that captive portal is configured and working properly, perform these tasks:

- [Verifying That Captive Portal Is Enabled on the Interface on page 76](#)
- [Verify That Captive Portal Is Working Correctly on page 76](#)

### Verifying That Captive Portal Is Enabled on the Interface

**Purpose** Verify that captive portal is configured on interface ge-0/0/10.

**Action** Use the operational mode command **show captive-portal interface *interface-name* detail**:

```
user@router> show captive-portal interface ge-0/0/10.0 detail
ge-0/0/10.0
  Supplicant mode: Multiple
  Number of retries: 3
  Quiet period: 60 seconds
  Configured CP session timeout: 3600 seconds
  Server timeout: 15 seconds
```

**Meaning** The output confirms that captive portal is configured on interface ge-0/0/10 with the default settings for number of retries, quiet period, CP session timeout, and server timeout.

### Verify That Captive Portal Is Working Correctly

**Purpose** Verify that captive portal is working on the router.

**Action** Connect a client to interface ge-0/0/10. From the client, open a Web browser and request a webpage. The captive portal login page that you designed should be displayed. After you enter your login information and are authenticated against the RADIUS server, the Web browser should display either the page you requested or the post-authentication URL that you configured.

## Troubleshooting

To troubleshoot captive portal, perform these tasks:

- [Troubleshooting Captive Portal on page 76](#)

### Troubleshooting Captive Portal

**Problem** The router does not return the captive portal login page when a user connected to a captive portal interface on the router requests a Web page.

**Solution** You can examine the ARP, DHCP, HTTPS, and DNS counters—if one or more of these counters are not incrementing, this provides an indication of where the problem lies. For example, if the client cannot get an IP address, check the router interface to determine



whether the DHCP counter is incrementing—if the counter increments, the DHCP packet was received by the router.

```
user@router> show captive-portal firewall ge-0/0/10.0
ge-0/0/10.0
  Filter name: dot1x_ge-0/0/10
  Counters:
  Name                               Bytes      Packets
  dot1x_ge-0/0/10_CP_arp             7616       119
  dot1x_ge-0/0/10_CP_dhcp             0           0
  dot1x_ge-0/0/10_CP_http             0           0
  dot1x_ge-0/0/10_CP_https            0           0
  dot1x_ge-0/0/10_CP_t_dns            0           0
  dot1x_ge-0/0/10_CP_u_dns            0           0
```

## Example: Connecting a RADIUS Server for 802.1X to an MX Series Router

802.1X is the IEEE standard for Port-Based Network Access Control (PNAC). You use 802.1X to control network access. Only users and devices providing credentials that have been verified against a user database are allowed access to the network. You can use a RADIUS server as the user database for 802.1X authentication, as well as for MAC RADIUS authentication.

This example describes how to connect a RADIUS server to an MX Series router, and configure it for 802.1X:

- [Requirements on page 77](#)
- [Overview and Topology on page 78](#)
- [Configuration on page 78](#)
- [Verification on page 79](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.2 or later for MX240, MX480, or MX960 routers running in enhanced LAN mode.
- One router acting as an authenticator port access entity (PAE). The ports on the authenticator PAE form a control gate that blocks all traffic to and from supplicants until they are authenticated.
- One RADIUS authentication server that supports 802.1X. The authentication server acts as the backend database and contains credential information for hosts (supplicants) that have permission to connect to the network.

Before you connect the server to the router, be sure you have:

- Configured enhanced LAN mode on the router.
- Performed basic bridging and VLAN configuration on the router.
- Configured users on the RADIUS authentication server.

## Overview and Topology

The MX Series router acts as an authenticator Port Access Entity (PAE). It blocks all traffic and acts as a control gate until the supplicant (client) is authenticated by the server. All other users and devices are denied access.

Consider an MX Series router that functions as an authenticator port. It is connected using the interface, ge-0/0/10, over the IP network to a RADIUS server. The router is also linked to a conference room using the interface, ge-0/0/1, to a printer using the interface, ge-0/0/20, to a hub using the interface, ge-0/0/8, and to two supplicants or clients over interfaces, ge-0/0/2 and ge-0/0/9 respectively.

**Table 5: Components of the Topology**

Property	Settings
Router hardware	MX Series router
VLAN name	<b>default</b>
One RADIUS server	Backend database with an address of <b>10.0.0.100</b> connected to the switch at port <b>ge-0/0/10</b>

In this example, connect the RADIUS server to access port **ge-0/0/10** on the MX Series router. The switch acts as the authenticator and forwards credentials from the supplicant to the user database on the RADIUS server. You must configure connectivity between the MX Series router and the RADIUS server by specifying the address of the server and configuring the secret password. This information is configured in an access profile on the switch.

## Configuration

### CLI Quick Configuration

To quickly connect the RADIUS server to the switch, copy the following commands and paste them into the switch terminal window:

```
[edit]
set access radius-server 10.0.0.100 secret juniper
set access radius-server 10.0.0.200 secret juniper
set access profile profile1 authentication-order radius
set access profile profile1 radius authentication-server [10.0.0.100 10.0.0.200]
```

### Step-by-Step Procedure

To connect the RADIUS server to the switch:

1. Define the address of the servers, and configure the secret password. The secret password on the switch must match the secret password on the server:
 

```
[edit]
user@switch# set access radius-server 10.0.0.100 secret juniper
user@switch# set access radius-server 10.0.0.200 secret juniper
```
2. Configure the authentication order, making **radius** the first method of authentication:
 

```
[edit]
user@switch# set access profile profile1 authentication-order radius
```
3. Configure a list of server IP addresses to be tried in order to authenticate the supplicant:

```
[edit]
user@switch# set access profile profile1 radius authentication-server [10.0.0.100
10.0.0.200]
```

**Results** Display the results of the configuration:

```
user@switch> show configuration access
radius-server {
  10.0.0.100
  port 1812;
  secret "$9$qPT3ApBSrv69rvWLVb.P5"; ## SECRET-DATA
}
}
profile profile1{
  authentication-order radius;
  radius {
    authentication-server 10.0.0.100 10.0.0.200;
  }
}
}
```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verify That the Switch and RADIUS Server are Properly Connected on page 79](#)

### Verify That the Switch and RADIUS Server are Properly Connected

**Purpose** Verify that the RADIUS server is connected to the switch on the specified port.

**Action** Ping the RADIUS server to verify the connection between the switch and the server:

```
user@switch> ping 10.0.0.100
PING 10.0.0.100 (10.0.0.100): 56 data bytes
64 bytes from 10.93.15.218: icmp_seq=0 ttl=64 time=9.734 ms
64 bytes from 10.93.15.218: icmp_seq=1 ttl=64 time=0.228 ms
```

**Meaning** ICMP echo request packets are sent from the switch to the target server at 10.0.0.100 to test whether it is reachable across the IP network. ICMP echo responses are being returned from the server, verifying that the switch and the server are connected.

## Example: Setting Up 802.1X in Conference Rooms to Provide Internet Access to Corporate Visitors on an MX Series Router

802.1X on MX Series routers provides LAN access to users who do not have credentials in the RADIUS database. These users, referred to as guests, are authenticated and typically provided with access to the Internet.

This example describes how to create a guest VLAN and configure 802.1X authentication for it.

- [Requirements on page 80](#)
- [Overview and Topology on page 80](#)
- [Configuration of a Guest VLAN That Includes 802.1X Authentication on page 81](#)
- [Verification on page 81](#)

## Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.2 or later for MX240, MX480, or MX960 routers running in enhanced LAN mode.
- One router acting as an authenticator port access entity (PAE). The ports on the authenticator PAE form a control gate that blocks all traffic to and from supplicants until they are authenticated.
- One RADIUS authentication server that supports 802.1X. The authentication server acts as the backend database and contains credential information for hosts (supplicants) that have permission to connect to the network.

Before you connect the server to the router, be sure you have:

- Configured enhanced LAN mode on the router.
- Performed basic bridging and VLAN configuration on the router.
- Configured users on the RADIUS authentication server.

## Overview and Topology

The MX Series router acts as an authenticator Port Access Entity (PAE). It blocks all traffic and acts as a control gate until the supplicant (client) is authenticated by the server. All other users and devices are denied access.

Consider an MX Series router that functions as an authenticator port. It is connected using the interface, ge-0/0/10, over the IP network to a RADIUS server. The router is also linked to a conference room using the interface, ge-0/0/1, to a printer using the interface, ge-0/0/20, to a hub using the interface, ge-0/0/8, and to two supplicants or clients over interfaces, ge-0/0/2 and ge-0/0/9 respectively.

**Table 6: Components of the Topology**

Property	Settings
Router hardware	MX Series router
VLAN name	<b>default</b>
One RADIUS server	Backend database with an address of <b>10.0.0.100</b> connected to the switch at port <b>ge-0/0/10</b>

In this example, access interface **ge-0/0/1** provides LAN connectivity in the conference room. Configure this access interface to provide LAN connectivity to visitors in the conference room who are not authenticated by the corporate VLAN.

## Configuration of a Guest VLAN That Includes 802.1X Authentication

**CLI Quick Configuration** To quickly configure a guest VLAN, with 802.1X authentication, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans guest-vlan vlan-id 300
set protocols authentication-access-control interface all dot1x guest-vlan guest-vlan
```

**Step-by-Step Procedure** To configure a guest VLAN that includes 802.1X authentication on an EX Series switch:

1. Configure the VLAN ID for the guest VLAN:

```
[edit]
user@switch# set bridge-domains guest-vlan vlan-id 300
```

2. Configure the guest VLAN under **dot1x** protocols:

```
[edit]
user@switch# set protocols authentication-access-control interface all dot1x guest-vlan
guest-vlan
```

**Results** Check the results of the configuration:

```
user@switch> show configuration
protocols {
  authentication-access-control {
    interface {
      all {
        dot1x {
          guest-vlan {
            guest-vlan;
          }
        }
      }
    }
  }
}
bridge-domains {
  guest-vlan {
    vlan-id 300;
  }
}
```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying That the Guest VLAN is Configured on page 82](#)

### Verifying That the Guest VLAN is Configured

**Purpose** Verify that the guest VLAN is created and that an interface has failed authentication and been moved to the guest VLAN.

**Action** Use the operational mode commands:

```
user@switch> show bridge-domain
```

Instance	Primary Table	Bridging Domain	Type	Active
vs1	bridge.0	dynamic	bridge	2
vs1	bridge.0	guest	bridge	0
vs1	bridge.0	guest-vlan	bridge	0
vs1	bridge.0	vlan_dyn	bridge	0

```
user@switch> show dot1x interface ge-0/0/1.0 detail
ge-0/0/1.0
```

```
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Single
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Disabled
  Reauthentication: Enabled
  Configured Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: guest-vlan
  Number of connected supplicants: 1
    Supplicant: user1, 00:00:00:00:13:23
      Operational state: Authenticated
      Authentication method: Radius
      Authenticated VLAN: vo11
      Dynamic Filter: match source-dot1q-tag 10 action deny
      Session Reauth interval: 60 seconds
      Reauthentication due in 50 seconds
```

**Meaning** The output from the **show bridge domain** command shows **guest-vlan** as the name of the VLAN and the VLAN ID as **300**.

The output from the **show dot1x interface ge-0/0/1.0 detail** command displays the **Guest VLAN membership** field, indicating that a supplicant at this interface failed 802.1X authentication and was passed through to the **guest-vlan**.

## Example: Configuring Static MAC Bypass of Authentication on an MX Series Router

To allow devices to access your LAN through 802.1X-configured interfaces without authentication, you can configure a static MAC bypass list on the MX Series router. The static MAC bypass list, also known as the *exclusion list*, specifies MAC addresses that are allowed on the router without a request to an authentication server.

You can use static MAC bypass of authentication to allow connection for devices that are not 802.1X-enabled, such as printers. If a host's MAC address is compared and matched against the static MAC address list, the nonresponsive host is authenticated and an interface opened for it.

This example describes how to configure static MAC bypass of authentication for two printers:

- [Requirements on page 83](#)
- [Overview and Topology on page 83](#)
- [Configuration on page 84](#)
- [Verification on page 85](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.2 or later for MX240, MX480, or MX960 routers running in enhanced LAN mode.
- One router acting as an authenticator port access entity (PAE). The ports on the authenticator PAE form a control gate that blocks all traffic to and from supplicants until they are authenticated.

Before you connect the server to the router, be sure you have:

- Configured enhanced LAN mode on the router.
- Performed basic bridging and VLAN configuration on the router.
- Configured users on the RADIUS authentication server.

### Overview and Topology

To permit printers access to the LAN, add them to the static MAC bypass list. The MAC addresses on this list are permitted access without authentication from the RADIUS server.

Consider an MX Series router that functions as an authenticator port. It is connected using the interface, ge-0/0/10, over the IP network to a RADIUS server. The router is also linked to a conference room using the interface, ge-0/0/1, to a printer using the interface, ge-0/0/20, to a hub using the interface, ge-0/0/8, and to two supplicants or clients over interfaces, ge-0/0/2 and ge-0/0/9 respectively.

The interfaces shown in [Table 7 on page 84](#) will be configured for static MAC authentication.

**Table 7: Components of the Static MAC Authentication Configuration Topology**

Property	Settings
Router hardware	MX Series router
VLAN name	default
Connections to integrated printer/fax/copier machines (no PoE required)	ge-0/0/19, MAC address 00:04:0f:fd:ac:fe ge-0/0/20, MAC address 00:04:ae:cd:23:5f

The printer with the MAC address 00:04:0f:fd:ac:fe is connected to access interface **ge-0/0/19**. A second printer with the MAC address 00:04:ae:cd:23:5f is connected to access interface **ge-0/0/20**. Both printers will be added to the static list and bypass 802.1X authentication.

## Configuration

### CLI Quick Configuration

To quickly configure static MAC authentication, copy the following commands and paste them into the router terminal window:

```
[edit]
set protocols authentication-access-control static [00:04:0f:fd:ac:fe 00:04:ae:cd:23:5f]
set protocols authentication-access-control interface all supplicant multiple
set protocols authentication-access-control authentication-profile-name profile1
```

### Step-by-Step Procedure

Configure static MAC authentication:

1. Configure MAC addresses **00:04:0f:fd:ac:fe** and **00:04:ae:cd:23:5f** as static MAC addresses:

```
[edit protocols]
user@router# set authentication-access-control static [00:04:0f:fd:ac:fe
00:04:ae:cd:23:5f]
```

2. Configure the 802.1X authentication method:

```
[edit protocols]
user@router# set authentication-access-control interface all supplicant multiple
```

3. Configure the authentication profile name (access profile name) to use for authentication:

```
[edit protocols]
user@router# set authentication-access-control authentication-profile-name profile1
```



**NOTE:** Access profile configuration is required only for 802.1X clients, not for static MAC clients.

### Results

Display the results of the configuration:

```
user@router> show
interfaces {
```



```

ge-0/0/19 {
  unit 0 {
    family bridge {
      vlan-id 10;
    }
  }
}
ge-0/0/20 {
  unit 0 {
    family bridge {
      vlan-id 10;
    }
  }
}
}
protocols {
  authentication-access-control {
    authentication-profile-name profile1;
    static [00:04:0f:fd:ac:fe 00:04:ae:cd:23:5f];
    interface {
      all {
        supplicant multiple;
      }
    }
  }
}
}

```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying Static MAC Bypass of Authentication on page 85](#)

### Verifying Static MAC Bypass of Authentication

**Purpose** Verify that the MAC address for both printers is configured and associated with the correct interfaces.

**Action** Use the operational mode command:

```
user@switch> show dot1x static-mac-address
```

MAC address	VLAN-Assignment	Interface
00:04:0f:fd:ac:fe	default	ge-0/0/19.0
00:04:ae:cd:23:5f	default	ge-0/0/20.0

**Meaning** The output field **MAC address** shows the MAC addresses of the two printers.

The output field **Interface** shows that the MAC address **00:04:0f:fd:ac:fe** can connect to the LAN through interface **ge-0/0/19.0** and that the MAC address **00:04:ae:cd:23:5f** can connect to the LAN through interface **ge-0/0/20.0**.

## Example: Applying Firewall Filters to Multiple Supplicants on Interfaces Enabled for 802.1X or MAC RADIUS Authentication on MX Series Routers

---

On MX Series routers, firewall filters that you apply to interfaces enabled for 802.1X or MAC RADIUS authentication are dynamically combined with the per-user policies sent to the switch from the RADIUS server. The switch uses internal logic to dynamically combine the interface firewall filter with the user policies from the RADIUS server and create an individualized policy for each of the multiple users or nonresponsive hosts that are authenticated on the interface.

This example describes how dynamic firewall filters are created for multiple supplicants on an 802.1X-enabled interface (the same principles shown in this example apply to interfaces enabled for MAC RADIUS authentication):

- [Requirements on page 86](#)
- [Overview and Topology on page 86](#)
- [Configuration on page 88](#)
- [Verification on page 90](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.2 or later for MX Series routers
- One MX Series router
- One RADIUS authentication server. The authentication server acts as the backend database and contains credential information for hosts (supplicants) that have permission to connect to the network.

Before you apply firewall filters to an interface for use with multiple supplicants, be sure you have:

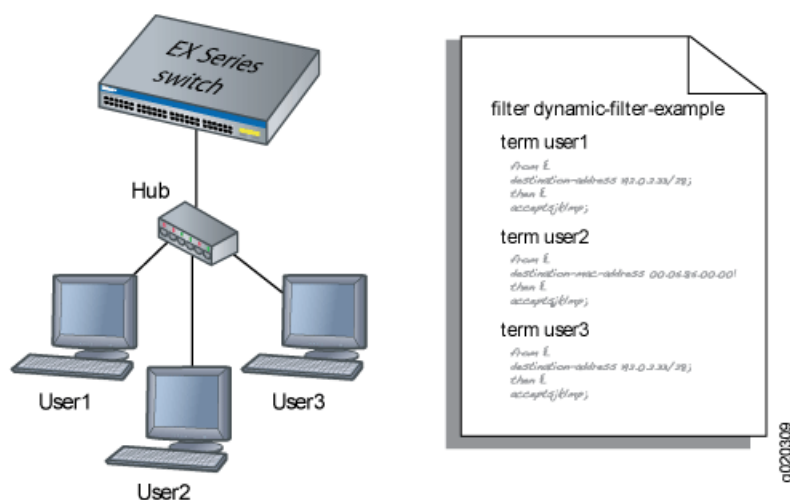
- Set up a connection between the router and the RADIUS server.
- Configured 802.1X authentication on the router, with the authentication mode for interface **ge-0/0/2** set to **multiple**.
- Configured users on the RADIUS authentication server.

### Overview and Topology

When the 802.1X configuration on an interface is set to multiple supplicant mode, the system dynamically combines interface firewall filter with the user policies sent to the router from the RADIUS server during authentication and creates separate terms for each user. Because there are separate terms for each user authenticated on the interface, you can, as shown in this example, use counters to view the activities of individual users that are authenticated on the same interface.

When a new user (or a nonresponsive host) is authenticated on an interface, the system adds a term to the firewall filter associated with the interface, and the term (policy) for each user is associated with the MAC address of the user. The term for each user is based on the user-specific filters set on the RADIUS server and the filters configured on the interface. For example, as shown in [Figure 5 on page 87](#), when User1 is authenticated by the MX Series router, the system creates the firewall filter **dynamic-filter-example**. When User2 is authenticated, another term is added to the firewall filter, and so on.

Figure 5: Conceptual Model: Dynamic Filter Updated for Each New User



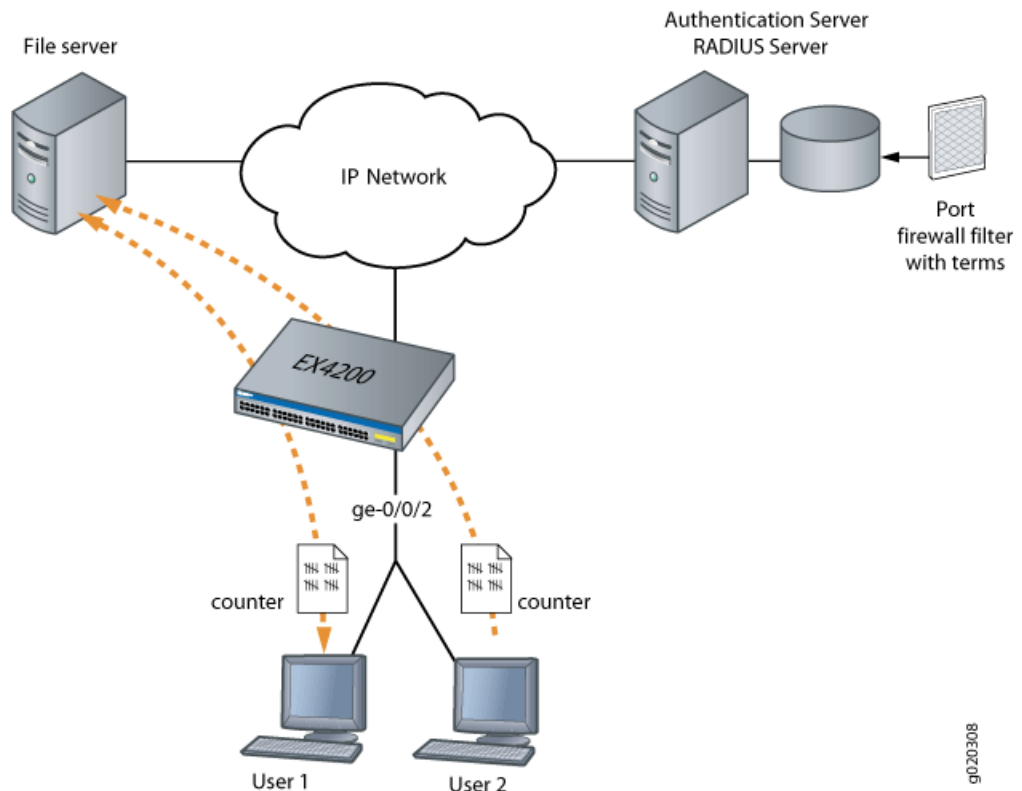
This is a conceptual model of the internal process—you cannot access or view the dynamic filter.



**NOTE:** If the firewall filter on the interface is modified after the user (or nonresponsive host) is authenticated, the modifications are not reflected in the dynamic filter unless the user is reauthenticated.

In this example, you configure a firewall filter to count the requests made by each endpoint authenticated on interface **ge-0/0/2** to the file server, which is located on subnet **192.0.2.16/28**, and set policer definitions to rate limit the traffic. [Figure 6 on page 88](#) shows the network topology for this example.

Figure 6: Multiple Supplicants on an 802.1X-Enabled Interface Connecting to a File Server



## Configuration

To configure firewall filters for multiple supplicants on 802.1X-enabled interfaces:

- [Configuring Firewall Filters on Interfaces with Multiple Supplicants on page 88](#)

### Configuring Firewall Filters on Interfaces with Multiple Supplicants

#### CLI Quick Configuration

To quickly configure firewall filters for multiple supplicants on an 802.1X-enabled interface copy the following commands and paste them into the router terminal window:

```
[edit]
set protocols authentication-access-control interface ge-0/0/2 supplicant multiple
set firewall family bridge filter filter1 term term1 from destination-address 192.0.2.16/28
set firewall policer p1 if-exceeding bandwidth-limit 1m
set firewall policer p1 if-exceeding burst-size-limit 1k
set firewall family bridge filter filter1 term term1 then count counter1
set firewall family bridge filter filter1 term term2 then policer p1
```

#### Step-by-Step Procedure

To configure firewall filters on an interface enabled for multiple supplicants:

1. Configure interface **ge-0/0/2** for multiple supplicant mode authentication:
 

```
[edit protocols]
user@router# set authentication-access-control interface ge-0/0/2 supplicant multiple
```
2. Set policer definition:

```

user@router# show policer p1 |display set
set firewall policer p1 if-exceeding bandwidth-limit 1m
set firewall policer p1 if-exceeding burst-size-limit 1k
set firewall policer p1 then discard

```

3. Configure a firewall filter to count packets from each user and a policer that limits the traffic rate. As each new user is authenticated on the multiple supplicant interface, this filter term will be included in the dynamically created term for the user:

```

[edit firewall family bridge]
user@router# set filter filter1 term term1 from destination-address 192.0.2.16/28
user@router# set filter filter1 term term1 then count counter1
user@router# set filter filter1 term term2 then policer p1

```

**Results** Check the results of the configuration:

```

user@router> show configuration

```

```

firewall {
  family bridge {
    filter filter1 {
      term term1 {
        from {
          destination-address {
            192.0.2.16/28;
          }
        }
        then count counter1;
      }
      term term2 {
        from {
          destination-address {
            192.0.2.16/28;
          }
        }
        then policer p1;
      }
    }
  }
}
policer p1 {
  if-exceeding {
    bandwidth-limit 1m;
    burst-size-limit 1k;
  }
  then discard;
}
}
protocols {
  authentication-access-control {
    interface ge-0/0/2 {
      supplicant multiple;
    }
  }
}

```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying Firewall Filters on Interfaces with Multiple Supplicants on page 90](#)

---

### Verifying Firewall Filters on Interfaces with Multiple Supplicants

---

<b>Purpose</b>	Verify that firewall filters are functioning on the interface with multiple supplicants.
<b>Action</b>	<ol style="list-style-type: none"><li>1. Check the results with one user authenticated on the interface. In this case, the user is authenticated on <b>ge-0/0/2</b>:  user@router&gt; <b>show dot1x firewall</b> Filter: dot1x_ge-0/0/2 Counters counter1_dot1x_ge-0/0/2_user1 100</li><li>2. When a second user, User2, is authenticated on the same interface, <b>ge-0/0/2</b>, you can verify that the filter includes the results for both of the users authenticated on the interface:  user@router&gt; <b>show dot1x firewall</b> Filter: dot1x-filter-ge-0/0/0 Counters counter1_dot1x_ge-0/0/2_user1 100 counter1_dot1x_ge-0/0/2_user2 400</li></ol>
<b>Meaning</b>	The results displayed by the <b>show dot1x firewall</b> command output reflect the dynamic filter created with the authentication of each new user. User1 accessed the file server located at the specified destination address 100 times, while User2 accessed the same file server 400 times.

## CHAPTER 7

# Configuring Media Access Control Security (MACsec)

- [Understanding Media Access Control Security \(MACsec\) on MX Series Routers on page 91](#)
- [Configuring Media Access Control Security \(MACsec\) on MX Series Routers on page 93](#)
- [Example: Configuring MACsec over an MPLS CCC on MX Series Routers on page 99](#)

## Understanding Media Access Control Security (MACsec) on MX Series Routers

Media Access Control Security (MACsec) is an industry-standard security technology that provides secure communication on Ethernet links. MACsec provides confidentiality, replay protection, and data integrity on Ethernet links between nodes. MACsec is standardized in IEEE 802.1AE.

MACsec allows you to secure an Ethernet link for almost all traffic, including frames from the Link Layer Discovery Protocol (LLDP), Link Aggregation Control Protocol (LACP), Dynamic Host Configuration Protocol (DHCP), Address Resolution Protocol (ARP), and other protocols that are not typically secured on an Ethernet link because of limitations with other security solutions.

This topic contains the following sections:

- [How MACsec Works on page 91](#)
- [Understanding Connectivity Associations and Secure Channels on page 92](#)
- [Understanding Static Connectivity Association Key Security Mode \(Security Mode for Router-to-Router Links\) on page 92](#)
- [Understanding MACsec Hardware Requirements for MX Series Routers on page 93](#)
- [Understanding MACsec Software Requirements for MX Series Routers on page 93](#)
- [Understanding the MACsec Feature License Requirement on page 93](#)

## How MACsec Works

The point-to-point links are secured after matching security keys—a user-configured pre-shared key when you enable MACsec using static connectivity association key (CAK) security mode. See [“Configuring Media Access Control Security \(MACsec\) on MX Series Routers” on page 93](#).

Once MACsec is enabled on a point-to-point Ethernet link, all traffic traversing the link is MACsec-secured through the use of data integrity checks and, if configured, encryption. You can configure the **set security macsec connectivity-association *connectivity-association-name* exclude-protocol** command to specify protocols whose packets are not secured using Media Access Control Security (MACsec) when MACsec is enabled on a link using static connectivity association key (CAK) security mode. When this option is enabled in a connectivity association that is attached to an interface, MACsec is not enabled for all packets of the specified protocols that are sent and received on the link.

The data integrity checks verify the integrity of the data. MACsec appends an 8-byte header and a 16-byte tail to all Ethernet frames traversing the MACsec-secured point-to-point Ethernet link, and the header and tail are checked by the receiving interface to ensure that the data was not compromised while traversing the link. If the data integrity check detects anything irregular about the traffic, the traffic is dropped.

The encryption used by MACsec ensures that the data in the Ethernet frame cannot be viewed by anybody monitoring traffic on the link. MACsec encryption is optional and user-configurable; you can enable MACsec to ensure the data integrity checks are performed while still sending unencrypted data “in the clear” over the MACsec-secured link, if desired.

Typically, MACsec is configured on point-to-point Ethernet links between MACsec-capable interfaces. If you want to enable MACsec on multiple Ethernet links, such as aggregated Ethernet interface bundles, you must configure MACsec individually on each point-to-point Ethernet link.

## Understanding Connectivity Associations and Secure Channels

MACsec is configured in connectivity associations. MACsec is enabled when a connectivity association is assigned to an interface.

When you enable MACsec using static connectivity association key (CAK) security mode, two security keys—a connectivity association key (CAK) that secures control plane traffic and a randomly-generated secure association key (SAK) that secures data plane traffic—are used to secure the point-to-point Ethernet link.

When you enable MACsec using static CAK, you have to create and configure a connectivity association. Two secure channels—one secure channel for inbound traffic and another secure channel for outbound traffic—are automatically created. The automatically-created secure channels do not have any user-configurable parameters; the secure channel configuration is derived from the connectivity association settings.

## Understanding Static Connectivity Association Key Security Mode (Security Mode for Router-to-Router Links)

You initially establish a MACsec-secured link using a pre-shared key when you are using static CAK security mode to enable MACsec. A pre-shared key includes a connectivity association name (CKN) and its own connectivity association key (CAK). The CKN and CAK are configured by the user in the connectivity association and must match on both ends of the link to initially enable MACsec.



The pre-shared keys must be configured on the endpoints of the link and the keys must be in agreement with each other. The MACsec Key Agreement (MKA) protocol is responsible for maintaining MACsec on the link, and decides which router on the point-to-point link becomes the key server. The key server then creates a SAK that is shared with the router at the other end of the point-to-point link only, and that SAK is used to secure all data traffic traversing the link. The key server will continue to periodically create and share a randomly-created SAK over the point-to-point link for as long as MACsec is enabled.

See [“Configuring Media Access Control Security \(MACsec\) on MX Series Routers” on page 93](#) for step-by-step instructions on enabling MACsec using static CAK security mode.

## Understanding MACsec Hardware Requirements for MX Series Routers

Starting in Junos OS Release 15.1R1, you can configure Media Access Control Security (MACsec) on MX Series routers with the enhanced 20-port Gigabit Ethernet MIC (model number MIC-3D-20GE-SFP-E).

MACsec can be configured on supported MX Series router interfaces when those routers are configured in a Virtual Chassis Configuration. Encryption and decryption are implemented in the hardware in line-rate mode. An additional overhead of 24 through 32 bytes (with SCI) is required for MACsec. On 20-port Gigabit Ethernet MICs, the SCI tag is always included.

For more information regarding MACsec, refer the following IEEE specifications:

- IEEE 802.1AE-2006. Media Access Control (MAC) Security
- IEEE 802.1X-2010. Port-Based Network Access Control. Defineds MACSec Key Agreement Protocol

## Understanding MACsec Software Requirements for MX Series Routers

MACsec is supported on MX Series routers with MACsec-capable interfaces. The SCI tag is always included on MX Series routers.

MACsec is supported on member links of an aggregated Ethernet (ae-) interface bundle, and also regular interfaces that are not part of an interface bundle.

## Understanding the MACsec Feature License Requirement

A feature license is not required to configure MACsec on a router.

### Related Documentation

- [Configuring Media Access Control Security \(MACsec\) on MX Series Routers on page 93](#)

---

## Configuring Media Access Control Security (MACsec) on MX Series Routers

Media Access Control Security (MACsec) is an industry-standard security technology that provides secure communication for almost all types of traffic on Ethernet links. MACsec provides point-to-point security on Ethernet links between directly-connected nodes and is capable of identifying and preventing most security threats, including denial

of service, intrusion, man-in-the-middle, masquerading, passive wiretapping, and playback attacks. MACsec is standardized in IEEE 802.1AE.

You can configure MACsec to secure point-to-point Ethernet links connecting MX Series routers with MACsec-capable MICs, or on Ethernet links connecting a switch to a host device such as a PC, phone, or server. Each point-to-point Ethernet link that you want to secure using MACsec must be configured independently. You can enable MACsec on router-to-router links or static connectivity association key (CAK) security mode. Both processes are provided in this document.



**BEST PRACTICE:** We recommend enabling MACsec using static CAK security mode on router-to-router links. Static CAK security mode ensures security by frequently refreshing to a new random secure association key (SAK) and by only sharing the SAK between the two devices on the MACsec-secured point-to-point link. Additionally, some optional MACsec features—replay protection, SCI tagging, and the ability to exclude traffic from MACsec—are only available for MACsec-secured router-to-router connections that are enabled using static CAK security mode.

Starting in Junos OS Release 14.2R2 and 15.1R1, you can configure Media Access Control Security (MACsec) on MX Series routers with the enhanced 20-port Gigabit Ethernet MIC (model number MIC-3D-20GE-SFP-E).

The configuration steps for both processes are provided in this document.

- 
- [Configuring MACsec Using Static Connectivity Association Key Security Mode \(Recommended for Enabling MACsec on Router-to-Router Links\)](#) on page 95

## Configuring MACsec Using Static Connectivity Association Key Security Mode (Recommended for Enabling MACsec on Router-to-Router Links)

You can enable MACsec using static connectivity association key (CAK) security mode or static secure association keys (SAK) security mode on a point-to-point Ethernet link connecting switches. This procedure shows you how to configure MACsec using static CAK security mode.



**BEST PRACTICE:** We recommend enabling MACsec using static CAK security mode on router-to-router links. Static CAK security mode ensures security by frequently refreshing to a new random secure association key (SAK) and by only sharing the SAK between the two devices on the MACsec-secured point-to-point link. Additionally, some optional MACsec features—replay protection, SCI tagging, and the ability to exclude traffic from MACsec—are only available for MACsec-secured router-to-router connections that are enabled using static CAK security mode.

When you enable MACsec using static CAK security mode, a pre-shared key is exchanged between the switches on each end of the point-to-point Ethernet link. The pre-shared key includes a connectivity association name (CKN) and a connectivity association key (CAK). The CKN and CAK are configured by the user in the connectivity association and must match on both ends of the link to initially enable MACsec.

After the pre-shared keys are exchanged and verified, the MACsec Key Agreement (MKA) protocol, which enables and maintains MACsec on the link, is enabled. The MKA is responsible for selecting one of the two switches on the point-to-point link as the key server. The key server then creates a randomized security key that is shared only with the other device over the MACsec-secured link. The randomized security key enables and maintains MACsec on the point-to-point link. The key server will continue to periodically create and share a randomly-created security key over the point-to-point link for as long as MACsec is enabled.

You enable MACsec using static CAK security mode by configuring a connectivity association on both ends of the link. All configuration is done within the connectivity association but outside of the secure channel. Two secure channels—one for inbound traffic and one for outbound traffic—are automatically created when using static CAK security mode. The automatically-created secure channels do not have any user-configurable parameters that cannot already be configured in the connectivity association.

To configure MACsec using static CAK security mode to secure a router-to-router Ethernet link:

1. Create a connectivity association. You can skip this step if you are configuring an existing connectivity association.

```
[edit security macsec]
user@host# set connectivity-association connectivity-association-name
For instance, to create a connectivity association named ca1, enter:
```

```
[edit security macsec]
user@host# set connectivity-association ca1
```

2. Configure the MACsec security mode as **static-cak** for the connectivity association:

```
[edit security macsec]
user@host# set connectivity-association connectivity-association-name security-mode
static-cak
```

For instance, to configure the MACsec security mode to **static-cak** on connectivity association **ca1**:

```
[edit security macsec]
user@host# set connectivity-association ca1 security-mode static-cak
```

3. Create the pre-shared key by configuring the connectivity association key name (CKN) and connectivity association key (CAK):

```
[edit security macsec]
user@host# set connectivity-association connectivity-association-name pre-shared-key ckn
hexadecimal-number
user@host# set connectivity-association connectivity-association-name pre-shared-key cak
hexadecimal-number
```

A pre-shared key is exchanged between directly-connected links to establish a MACsec-secure link. The pre-shared-key includes the CKN and the CAK. The CKN is a 64-digit hexadecimal number and the CAK is a 32-digit hexadecimal number. The CKN and the CAK must match on both ends of a link to create a MACsec-secured link.



**NOTE:** To maximize security, we recommend configuring all 64 digits of a CKN and all 32 digits of a CAK.

If you do not configure all 64 digits of a CKN or all 32 digits of a CAK, however, all remaining digits will be auto-configured to 0.

After the pre-shared keys are successfully exchanged and verified by both ends of the link, the MACsec Key Agreement (MKA) protocol is enabled and manages the secure link. The MKA protocol then elects one of the two directly-connected switches as the key server. The key server then shares a random security with the other device over the MACsec-secure point-to-point link. The key server will continue to periodically create and share a random security key with the other device over the MACsec-secured point-to-point link as long as MACsec is enabled.

To configure a CKN of **37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311** and CAK of **228ef255aa23ff6729ee664acb66e91f** on connectivity association **ca1**:

```
[edit security macsec]
user@host# set connectivity-association ca1 pre-shared-key ckn
37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311
user@host# set connectivity-association ca1 pre-shared-key cak
228ef255aa23ff6729ee664acb66e91f
```



**NOTE:** MACsec is not enabled until a connectivity association is attached to an interface. See the final step of this procedure to attach a connectivity association to an interface.



**NOTE:** The SCI tag is always encrypted on MX Series routers. As a result, using the `include-sci` statement in the connectivity association is redundant and not supported.

4. (Optional) Set the MKA key server priority:

```
[edit security macsec connectivity-association connectivity-association-name]
user@host# set mka key-server-priority priority-number
```

Specifies the key server priority used by the MKA protocol to select the key server. The switch with the lower *priority-number* is selected as the key server.

The default *priority-number* is 16.

If the **key-server-priority** is identical on both sides of the point-to-point link, the MKA protocol selects the interface with the lower MAC address as the key server. Therefore, if this statement is not configured in the connectivity associations at each end of a MACsec-secured point-to-point link, the interface with the lower MAC address becomes the key server.

To change the key server priority to 0 to increase the likelihood that the current device is selected as the key server when MACsec is enabled on the interface using connectivity association **ca1**:

```
[edit security macsec connectivity-association ca1]
user@host# set mka key-server-priority 0
```

To change the key server priority to 255 to decrease the likelihood that the current device is selected as the key server in connectivity association **ca1**:

```
[edit security macsec connectivity-association ca1]
user@host# set mka key-server-priority 255
```

5. (Optional) Set the MKA transmit interval:

```
[edit security macsec connectivity-association connectivity-association-name]
user@host# set mka transmit-interval interval
```

The MKA transmit interval setting sets the frequency for how often the MKA protocol data unit (PDU) is sent to the directly connected device to maintain MACsec connectivity on the link. A lower *interval* increases bandwidth overhead on the link; a higher *interval* optimizes MKA protocol communication.

The default *interval* is 2000ms. We recommend increasing the interval to 6000 ms in high-traffic load environments. The transmit interval settings must be identical on both ends of the link when MACsec using static CAK security mode is enabled.

For instance, if you wanted to increase the MKA transmit interval to 6000 milliseconds when connectivity association **ca1** is attached to an interface:

```
[edit security macsec connectivity-association ca1]
user@host# set mka transmit-interval 6000
```

6. (Optional) Disable MACsec encryption:

```
[edit security macsec connectivity-association connectivity-association-name]  
user@host# set no-encryption
```

Encryption is enabled for all traffic entering or leaving the interface when MACsec is enabled using static CAK security mode, by default.

When encryption is disabled, traffic is forwarded across the Ethernet link in clear text. You are able to view unencrypted data in the Ethernet frame traversing the link when you are monitoring it. The MACsec header is still applied to the frame, however, and all MACsec data integrity checks are run on both ends of the link to ensure the traffic sent or received on the link has not been tampered with and does not represent a security threat.

7. (Optional) Set an offset for all packets traversing the link:

```
[edit security macsec connectivity-association connectivity-association-name]  
user@host# set offset (0 | 30 | 50)
```

For instance, if you wanted to set the offset to 30 in the connectivity association named **ca1**:

```
[edit security macsec connectivity-association ca1]  
user@host# set offset 30
```

The default offset is 0. All traffic in the connectivity association is encrypted when encryption is enabled and an **offset** is not set.

When the offset is set to 30, the IPv4 header and the TCP/UDP header are unencrypted while encrypting the rest of the traffic. When the offset is set to 50, the IPv6 header and the TCP/UDP header are unencrypted while encrypting the rest of the traffic.

You would typically forward traffic with the first 30 or 50 octets unencrypted if a feature needed to see the data in the octets to perform a function, but you otherwise prefer to encrypt the remaining data in the frames traversing the link. Load balancing features, in particular, typically need to see the IP and TCP/UDP headers in the first 30 or 50 octets to properly load balance traffic.

8. (Optional) Enable replay protection.

```
[edit security macsec connectivity-association connectivity-association-name]  
user@host# set replay-protect replay-window-size number-of-packets
```

When MACsec is enabled on a link, an ID number is assigned to each packet on the MACsec-secured link.

When replay protection is enabled, the receiving interface checks the ID number of all packets that have traversed the MACsec-secured link. If a packet arrives out of sequence and the difference between the packet numbers exceeds the replay protection window size, the packet is dropped by the receiving interface. For instance, if the replay protection window size is set to five and a packet assigned the ID of 1006 arrives on the receiving link immediately after the packet assigned the ID of 1000, the packet that is assigned the ID of 1006 is dropped because it falls outside the parameters of the replay protection window.

Replay protection is especially useful for fighting man-in-the-middle attacks. A packet that is replayed by a man-in-the-middle attacker on the Ethernet link will arrive on

the receiving link out of sequence, so replay protection helps ensure the replayed packet is dropped instead of forwarded through the network.

Replay protection should not be enabled in cases where packets are expected to arrive out of order.

You can require that all packets arrive in order by setting the replay window size to 0.

To enable replay protection with a window size of five on connectivity association **ca1**:

```
[edit security macsec connectivity-association ca1]
user@host# set replay-protect replay-window-size 5
```

9. (Optional) Exclude a protocol from MACsec:

```
[edit security macsec connectivity-association connectivity-association-name]
user@host# set exclude-protocol protocol-name
```

For instance, if you did not want Link Level Discovery Protocol (LLDP) to be secured using MACsec:

```
[edit security macsec connectivity-association connectivity-association-name]
user@host# set exclude-protocol lldp
```

When this option is enabled, MACsec is disabled for all packets of the specified protocol—in this case, LLDP—that are sent or received on the link.

10. Assign the connectivity association to an interface:

```
[edit security macsec]
user@host# set interfaces interface-names connectivity-association
connectivity-association-name
```

Assigning the connectivity association to an interface is the final configuration step to enabling MACsec on an interface.

For instance, to assign connectivity association **ca1** to interface **ge-0/0/1**:

```
[edit security macsec]
user@host# set interfaces ge-0/0/1 connectivity-association ca1
```

MACsec using static CAK security mode is not enabled until a connectivity association on the opposite end of the link is also configured, and contains pre-shared keys that match on both ends of the link.

## Example: Configuring MACsec over an MPLS CCC on MX Series Routers

This example shows how to enable MACsec to secure sensitive traffic traveling from a user at one site to a user at another site over a basic MPLS CCC.

- [Requirements on page 99](#)
- [Overview and Topology on page 100](#)
- [Configuring MPLS on page 102](#)
- [Configuring MACsec on page 108](#)
- [Configuring VLANs to Direct Traffic onto the MACsec-Secured CCC on page 111](#)
- [Verification on page 114](#)

### Requirements

This example uses the following hardware and software components:

- Three MX Series routers used as the PE and provider routers in the MPLS network
- One MX Series router used as the CE router connecting site A to the MPLS network
- One MX240, MX480, or MX960 router with the enhanced 20-port Gigabit Ethernet MIC (model number MIC-3D-20GE-SFP-E) used as the CE router connecting site B to the MPLS network
- Junos OS Release 15.1R1 or later running on all MX Series routers in the MPLS network (PE1, PE2, or the provider router)
- Junos OS Release 15.1R1 or later running on the CE router at site A and the CE router at site B

## Overview and Topology

In this example, financially-sensitive company data is often sent between a user at site A and a user at site B. The company wants to ensure that all network traffic traveling from the user at site A to the user at site B is highly secure and cannot be viewed or corrupted by an attacker. The company is using the industry-standard Layer 2 security provided by MACsec, which provides encryption to ensure data cannot be viewed by attackers and integrity checks to ensure transmitted data is not corrupted, to secure all traffic traveling on the CCC through the MPLS cloud connecting the sites. VLANs are configured at both sites to ensure traffic traveling between the two users traverses the sites over the MACsec-secured CCC.

The MPLS network in this example includes two provider edge (PE) routers—PE1 and PE2—and one provider (transit) router. PE1 connects the customer edge (CE) router at site A to the MPLS network and PE2 connects the CE router at site B to the MPLS network. MACsec is enabled on the CCC connecting the CE routers at site A and site B to secure traffic traveling between the sites over the CCC. A VLAN that includes the interfaces that connect the users to the CE routers, interface ge-0/0/0 on the CE router at site A and interface ge-0/0/2 on the CE router at site B, and the interfaces that connect the CE routers to the MPLS cloud (ge-0/0/0 on the site A CE router and xe-0/1/0 on the site B CE router), is used to direct all traffic between the users onto the MACsec-secured CCC.

[Table 8 on page 101](#) provides a summary of the MPLS network components in this topology.

[Table 9 on page 102](#) provides a summary of the MACsec connectivity association used in this topology. MACsec is enabled by creating a connectivity association on the interfaces at each end of a link. MACsec is enabled when the interfaces at each end of the link exchange pre-shared keys—the pre-shared keys are defined in the connectivity association—to secure the link for MACsec.

[Table 10 on page 102](#) provides a summary of the bridge domain and VLAN IDs used in this topology. The VLAN is used in this topology to direct all communication from the user at site A to the user at site B onto the MACsec-secured CCC.



Table 8: Components of the MPLS Topology

Component	Description
PE1	<p>PE router.</p> <p>lo0:</p> <ul style="list-style-type: none"> <li>IP address: 130.1.1.1/32</li> <li>Participates in OSPF and RSVP.</li> </ul> <p>ge-0/0/0:</p> <ul style="list-style-type: none"> <li>Customer edge interface connecting site A to the MPLS network.</li> <li>CCC connecting to xe-0/1/1 on PE2.</li> </ul> <p>ge-0/0/1:</p> <ul style="list-style-type: none"> <li>Core interface connecting PE1 to the provider router.</li> <li>IP address: 10.1.5.2/24</li> <li>Participates in OSPF, RSVP, and MPLS.</li> </ul>
Provider	<p>Provider router.</p> <p>lo0:</p> <ul style="list-style-type: none"> <li>IP address: 130.1.1.2/32</li> <li>Participates in OSPF and RSVP.</li> </ul> <p>ge-0/0/10:</p> <ul style="list-style-type: none"> <li>Core interface connecting the provider router to PE1.</li> <li>IP address: 10.1.5.1/24</li> <li>Participates in OSPF, RSVP, and MPLS.</li> </ul> <p>xe-0/0/0:</p> <ul style="list-style-type: none"> <li>Core interface connecting the provider router to PE2.</li> <li>IP address: 10.1.9.1/24</li> <li>Participates in OSPF, RSVP, and MPLS.</li> </ul>
PE2	<p>PE router.</p> <p>lo0:</p> <ul style="list-style-type: none"> <li>IP address: 130.1.1.3/32</li> <li>Participates in OSPF and RSVP.</li> </ul> <p>xe-0/1/0</p> <ul style="list-style-type: none"> <li>Core interface connecting PE2 to the provider router.</li> <li>IP address: 10.1.9.2/24</li> <li>Participates in OSPF, RSVP, and MPLS.</li> </ul> <p>xe-0/1/1</p> <ul style="list-style-type: none"> <li>Customer edge interface connecting site B to the MPLS network.</li> <li>CCC connecting to ge-0/0/0 on PE1.</li> </ul>

Table 8: Components of the MPLS Topology (*continued*)

Component	Description
<code>lsp_to_pe2_xe1</code> label-switched path	Label-switched path from PE1 to PE2.
<code>lsp_to_pe1_ge0</code> label-switched path	Label-switched path from PE2 to PE1.

Table 9: MACsec Connectivity Association Summary

Connectivity Association	Description
<code>ccc-macsec</code>	<p>Connectivity association enabling MACsec on CCC connecting site A to site B.</p> <p>The connectivity association is enabled on the following interfaces:</p> <ul style="list-style-type: none"> <li>Site A CE router: <code>ge-0/0/0</code></li> <li>Site B CE router: <code>xe-0/1/0</code></li> </ul>

Table 10: Bridge Domains Summary

Bridge Domain	Description
<code>macsec</code>	<p>VLAN directing traffic between the user at site A and the user at site B onto the MACsec-secured CCC.</p> <p>The bridge domain includes the following interfaces:</p> <ul style="list-style-type: none"> <li>Site A CE router: <code>ge-0/0/0</code></li> <li>Site A CE router: <code>ge-0/0/1</code></li> <li>Site B CE router: <code>xe-0/1/0</code></li> <li>Site B CE router: <code>ge-0/0/2</code></li> </ul>

## Configuring MPLS

This section explains how to configure MPLS on each router in the MPLS network.

It includes the following sections:

- [Configuring MPLS on PE1 on page 102](#)
- [Configuring MPLS on the Provider Router on page 104](#)
- [Configuring MPLS on PE2 on page 106](#)
- [Results on page 107](#)

### Configuring MPLS on PE1

#### CLI Quick Configuration

To quickly configure the MPLS configuration on the PE1 router, use the following commands:

```
[edit]
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
set protocols mpls label-switched-path lsp_to_pe2_xe1 to 130.1.1.3
```

```

set protocols mpls interface ge-0/0/1.0
set protocols rsvp interface lo0.0
set protocols rsvp interface ge-0/0/1.0
set interfaces lo0 unit 0 family inet address 130.1.1.1/32
set interfaces ge-0/0/1 unit 0 family inet address 10.1.5.2/24
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces ge-0/0/0 unit 0 family ccc
set protocols connections remote-interface-switch ge-1-to-pe2 interface ge-0/0/0.0
set protocols connections remote-interface-switch ge-1-to-pe2 transmit-lsp lsp_to_pe2_xe1
set protocols connections remote-interface-switch ge-1-to-pe2 receive-lsp lsp_to_pe1_ge0

```

### Step-by-Step Procedure

To configure MPLS on router PE1:

1. Configure OSPF with traffic engineering enabled:  

```
[edit protocols]
user@router-PE1# set ospf traffic-engineering
```
2. Configure OSPF on the loopback address and the core interfaces:  

```
[edit protocols]
user@router-PE1# set ospf area 0.0.0.0 interface lo0.0
user@router-PE1# set ospf area 0.0.0.0 interface ge-0/0/1.0
```
3. Configure MPLS on this router, PE1, with an LSP to the PE2 router:  

```
[edit protocols]
user@router-PE1# set mpls label-switched-path lsp_to_pe2_xe1 to 130.1.1.3
```
4. Configure MPLS on the core interfaces:  

```
[edit protocols]
user@router-PE1# set mpls interface ge-0/0/1.0
```
5. Configure RSVP on the loopback interface and the core interfaces:  

```
[edit protocols]
user@router-PE1# set rsvp interface lo0.0
user@router-PE1# set rsvp interface ge-0/0/1.0
```
6. Configure IP addresses for the loopback interface and the core interfaces:  

```
[edit]
user@router-PE1# set interfaces lo0 unit 0 family inet address 130.1.1.1/32
user@router-PE1# set interfaces ge-0/0/1 unit 0 family inet address 10.1.5.2/24
```
7. Configure **family mpls** on the logical unit of the core interface addresses:  

```
[edit]
user@router-PE1# set interfaces ge-0/0/1 unit 0 family mpls
```
8. Configure the logical unit of the customer edge interface as a CCC:  

```
[edit interfaces ge-0/0/0 unit 0]
user@PE-1# set family ccc
```
9. Configure the interface-based CCC from PE1 to PE2:  

```
[edit protocols]
user@PE-1# set connections remote-interface-switch ge-1-to-pe2 interface ge-0/0/0.0
user@PE-1# set connections remote-interface-switch ge-1-to-pe2 transmit-lsp
lsp_to_pe2_xe1
user@PE-1# set connections remote-interface-switch ge-1-to-pe2 receive-lsp lsp_to_pe1_ge0
```

**Results** Display the results of the configuration:

```

user@PE-1> show configuration

interfaces {
  ge-0/0/0 {

```

```
    unit 0 {
        family ccc;
    }
}
ge-0/0/1 {
    unit 0 {
        family inet {
            address 130.1.5.2/24;
        }
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 130.1.1.1/32;
        }
    }
}
}
protocols {
    rsvp {
        interface lo0.0;
        interface ge-0/0/1.0;
    }
    mpls {
        label-switched-path lsp_to_pe2_xe1 {
            to 130.1.1.3;
        }
        interface ge-0/0/1.0;
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface lo0.0;
            interface ge-0/0/1.0;
        }
    }
    connections {
        remote-interface-switch ge-1-to-pe2 {
            interface ge-0/0/0.0;
            transmit-lsp lsp_to_pe2_xe1;
            receive-lsp lsp_to_pe1_ge0;
        }
    }
}
```

---

### Configuring MPLS on the Provider Router

#### CLI Quick Configuration

To quickly configure the MPLS configuration on the provider router, use the following commands:

```
[edit]
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/10.0
```

```

set protocols ospf area 0.0.0.0 interface xe-0/0/0.0
set protocols mpls interface ge-0/0/10.0
set protocols mpls interface xe-0/0/0.0
set protocols mpls label-switched-path lsp_to_pe2_xe1 to 130.1.1.3
set protocols rsvp interface lo0.0
set protocols rsvp interface ge-0/0/10.0
set protocols rsvp interface xe-0/0/0.0
set interfaces lo0 unit 0 family inet address 130.1.1.2/32
set interfaces ge-0/0/10 unit 0 family inet address 10.1.5.1/24
set interfaces ge-0/0/10 unit 0 family mpls
set interfaces xe-0/0/0 unit 0 family inet address 10.1.9.1/24
set interfaces xe-0/0/0 unit 0 family mpls

```

### Step-by-Step Procedure

To configure the provider router:

1. Configure OSPF with traffic engineering enabled:  

```

[edit protocols]
user@router-P# set ospf traffic-engineering

```
2. Configure OSPF on the loopback interface and the core interfaces:  

```

[edit protocols]
user@router-P# set ospf area 0.0.0.0 interface lo0.0
user@router-P# set ospf area 0.0.0.0 interface ge-0/0/10.0
user@router-P# set ospf area 0.0.0.0 interface xe-0/0/0.0

```
3. Configure MPLS on the core interfaces on the router:  

```

[edit protocols]
user@router-P# set mpls interface ge-0/0/10.0
user@router-P# set mpls interface xe-0/0/0.0

```
4. Configure RSVP on the loopback interface and the core interfaces:  

```

[edit protocols]
user@router-P# set rsvp interface lo0.0
user@router-P# set rsvp interface ge-0/0/10.0
user@router-P# set rsvp interface xe-0/0/0.0

```
5. Configure IP addresses for the loopback interface and the core interfaces:  

```

[edit]
user@router-P# set interfaces lo0 unit 0 family inet address 130.1.1.2/32
user@router-P# set interfaces ge-0/0/10 unit 0 family inet address 10.1.5.1/24
user@router-P# set interfaces xe-0/0/0 unit 0 family inet address 10.1.9.1/24

```
6. Configure **family mpls** on the logical unit of the core interface addresses:  

```

[edit]
user@router-P# set interfaces ge-0/0/10 unit 0 family mpls
user@router-P# set interfaces xe-0/0/0 unit 0 family mpls

```
7. Configure the LSP to the PE2 router:  

```

[edit]
user@router-P# set protocols mpls label-switched-path lsp_to_pe2_xe1 to 130.1.1.3

```

**Results** Display the results of the configuration:

```

user@router-P> show configuration

```

```

interfaces {
  ge-0/0/10 {
    unit 0 {
      family inet {
        address 10.1.5.1/24;
      }
    }
  }
}

```

```

        family mpls;
    }
}
xe-0/0/0 {
    unit 0 {
        family inet {
            address 10.1.9.1/24;
        }
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 130.1.1.2/32;
        }
    }
}
}
protocols {
    rsvp {
        interface lo0.0;
        interface ge-0/0/10.0;
        interface xe-0/0/0.0;
    }
    mpls {
        label-switched-path lsp_to_pe2_xe1 {
            to 130.1.1.3;
        }
        interface ge-0/0/10.0;
        interface xe-0/0/0.0;
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface lo0.0;
            interface ge-0/0/10.0;
            interface xe-0/0/0.0;
        }
    }
}
}

```

### Configuring MPLS on PE2

#### CLI Quick Configuration

To quickly configure the MPLS configuration on router PE2, use the following commands:

```

[edit]
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface xe-0/1/0.0
set protocols mpls label-switched-path lsp_to_pe1_ge0 to 130.1.1.1
set protocols mpls interface xe-0/1/0.0
set protocols rsvp interface lo0.0
set protocols rsvp interface xe-0/1/0.0
set interfaces lo0 unit 0 family inet address 130.1.1.3/32
set interfaces xe-0/1/0 unit 0 family inet address 10.1.9.2/24

```

```

set interfaces xe-0/1/0 unit 0 family mpls
set interfaces xe-0/1/1 unit 0 family ccc
set protocols connections remote-interface-switch xe-1-to-pe1 interface xe-0/1/1.0
set protocols connections remote-interface-switch xe-1-to-pe1 transmit-lsp lsp_to_pe1_ge0
set protocols connections remote-interface-switch xe-1-to-pe1 receive-lsp lsp_to_pe2_xe1

```

### Step-by-Step Procedure

To configure router PE2:

1. Configure OSPF with traffic engineering enabled:  

```

[edit protocols]
user@router-PE2# set ospf traffic-engineering

```
2. Configure OSPF on the loopback interface and the core interface:  

```

[edit protocols]
user@router-PE2# set ospf area 0.0.0.0 interface lo0.0
user@router-PE2# set ospf area 0.0.0.0 interface xe-0/1/0.0

```
3. Configure MPLS on this router (PE2) with a label-switched path (LSP) to the other PE router (PE1):  

```

[edit protocols]
user@router-PE2# set mpls label-switched-path lsp_to_pe1_ge0 to 130.1.1.1

```
4. Configure MPLS on the core interface:  

```

[edit protocols]
user@router-PE2# set mpls interface xe-0/1/0.0

```
5. Configure RSVP on the loopback interface and the core interface:  

```

[edit protocols]
user@router-PE2# set rsvp interface lo0.0
user@router-PE2# set rsvp interface xe-0/1/0.0

```
6. Configure IP addresses for the loopback interface and the core interface:  

```

[edit]
user@router-PE2# set interfaces lo0 unit 0 family inet address 130.1.1.3/32
user@router-PE2# set interfaces xe-0/1/0 unit 0 family inet address 10.1.9.2/24

```
7. Configure **family mpls** on the logical unit of the core interface:  

```

[edit]
user@router-PE2# set interfaces xe-0/1/0 unit 0 family mpls

```
8. Configure the logical unit of the customer edge interface as a CCC:  

```

[edit interfaces xe-0/1/1 unit 0]
user@router-PE2# set family ccc

```
9. Configure the interface-based CCC between the primary edge routers:  

```

[edit protocols]
user@router-PE2# set connections remote-interface-switch xe-1-to-pe1 interface xe-0/1/1.0
user@router-PE2# set connections remote-interface-switch xe-1-to-pe1 transmit-lsp
lsp_to_pe1_ge0
user@router-PE2# set connections remote-interface-switch xe-1-to-pe1 receive-lsp
lsp_to_pe2_xe1

```

### Results

Display the results of the configuration:

```
user@router-PE2> show configuration
```

```

interfaces {
  xe-0/1/0 {
    unit 0 {

```

```
        family inet {
            address 10.1.9.2/24;
        }
        family mpls;
    }
}
xe-0/1/1 {
    unit 0 {
        family ccc;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 130.1.1.3/32;
        }
    }
}
}
protocols {
    rsvp {
        interface lo0.0;
        interface xe-0/1/0.0;
    }
    mpls {
        label-switched-path lsp_to_pe1_ge0 {
            to 130.1.1.1;
        }
        interface xe-0/1/0.0;
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface lo0.0;
            interface xe-0/1/0.0;
        }
    }
    connections {
        remote-interface-switch xe-1-to-pe1 {
            interface xe-0/1/1.0;
            transmit-lsp lsp_to_pe1_ge0;
            receive-lsp lsp_to_pe2_xe1;
        }
    }
}
```

## Configuring MACsec

This section explains how to configure MACsec on each router in the topology.

It includes the following sections:

- [Configuring MACsec on the Site A CE Router to Secure Traffic to Site B on page 109](#)
- [Configuring MACsec on the Site B CE Router to Secure Traffic to Site A on page 110](#)



## Configuring MACsec on the Site A CE Router to Secure Traffic to Site B

<b>CLI Quick Configuration</b>	<pre>[edit] set security macsec connectivity-association ccc-macsec security-mode static-cak set security macsec connectivity-association ccc-macsec pre-shared-key ckn 37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311 set security macsec connectivity-association ccc-macsec pre-shared-key cak 228ef255aa23ff6729ee664acb66e91f set security macsec interfaces ge-0/0/0 connectivity-association ccc-macsec</pre>
<b>Step-by-Step Procedure</b>	<p>In this example, the traffic between the users that often exchange financially-sensitive data is sent between the sites on a CCC through the MPLS cloud. MACsec is enabled on the CCC by configuring a MACsec connectivity association on the interfaces on the site A and site B CE routers that connect to the MPLS PE routers. The connectivity associations must have matching connectivity-association names (in this example, <b>ccc-macsec</b>), matching CKNs (in this example, <b>37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311</b>), and CAKs (in this example, <b>228ef255aa23ff6729ee664acb66e91f</b>) in order to establish a MACsec-secure connection.</p>

To enable MACsec on the CCC connecting site A to site B, perform the following procedure on the site A CE router:

1. Create the connectivity association named **ccc-macsec**, and configure the MACsec security mode as **static-cak**:

```
[edit security macsec]
user@router-CE-A# set connectivity-association ccc-macsec security-mode static-cak
```

2. Create the pre-shared key by configuring the CKN and CAK:

```
[edit security macsec]
user@router-CE-A# set connectivity-association ccc-macsec pre-shared-key ckn
37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311
user@router-CE-A# set connectivity-association ccc-macsec pre-shared-key cak
228ef255aa23ff6729ee664acb66e91f
```

3. Assign the connectivity association to the interface connecting to the PE1 router:

```
[edit security macsec]
user@router-CE-A# set interfaces ge-0/0/0 connectivity-association ccc-macsec
```

This completes the steps for configuring the connectivity association on one end of the CCC. MACsec is not enabled until a connectivity association with matching pre-shared keys is enabled on the opposite end of a link, which in this case is the interface on the site B CE router, of the CCC. The process for configuring the connectivity association on the site B CE router is described in the following section.

**Results** Display the results of the configuration:

```
user@router-CE-A> show configuration

security {
  macsec {
    connectivity-association {
      ccc-macsec {
        pre-shared-key {
          cak "$9$rJ-lWLxNdw24Xxik.PQzreK"; ## SECRET-DATA
```

```

        ckn37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311;
    }
    security-mode {
        static-cak;
    }
}
}
interfaces {
    ge-0/0/0 {
        connectivity-association {
            ccc-macsec;
        }
    }
}
}
}

```

### Configuring MACsec on the Site B CE Router to Secure Traffic to Site A

#### CLI Quick Configuration

```

[edit]
set security macsec connectivity-association ccc-macsec security-mode static-cak
set security macsec connectivity-association ccc-macsec pre-shared-key ckn
37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311
set security macsec connectivity-association ccc-macsec pre-shared-key cak
228ef255aa23ff6729ee664acb66e91f
set security macsec interfaces xe-0/1/0 connectivity-association ccc-macsec

```

#### Step-by-Step Procedure

Traffic travels from site B to site A over the MPLS network using a CCC. MACsec is enabled on the CCC by configuring a MACsec connectivity association on the interfaces on the site A and site B CE routers that connect to the MPLS PE routers. The connectivity associations must have matching connectivity-association names (in this example, **ccc-macsec**), matching CKNs (**37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311**), and matching CAKs (**228ef255aa23ff6729ee664acb66e91f**) in order to establish a MACsec-secure connection.

To enable MACsec on the CCC connecting site B to site A, perform the following procedure on the site B CE router:

1. Create the connectivity association named **ccc-macsec**, and configure the MACsec security mode as **static-cak**:

```

[edit security macsec]
user@router-CE-B# set connectivity-association ccc-macsec security-mode static-cak

```

2. Create the pre-shared key by configuring the CKN and CAK:

```

[edit security macsec]
user@router-CE-B# set connectivity-association ccc-macsec pre-shared-key ckn
37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311
user@router-CE-B# set connectivity-association ccc-macsec pre-shared-key cak
228ef255aa23ff6729ee664acb66e91f

```

3. Assign the connectivity association to the interface connecting to router PE2:

```

[edit security macsec]
user@router-CE-B# set interfaces xe-0/1/0 connectivity-association ccc-macsec

```

MACsec is enabled for the CCC after the pre-shared keys are exchanged, which is shortly after this procedure is completed.

**Results** Display the results of the configuration:

```
user@router-CE-B> show configuration
```

```
security {
  macsec {
    connectivity-association {
      ccc-macsec {
        security-mode {
          static-cak;
        }
        pre-shared-key {
          cak "$9$rJ-lWLxNdw24Xxik.PQzreK"; ## SECRET-DATA
          ckn 37c9c2c45ddd012aa5bc8ef284aa23ff6729ee2e4acb66e91fe34ba2cd9fe311;
        }
      }
    }
  }
  interfaces {
    xe-0/1/0 {
      connectivity-association {
        ccc-macsec;
      }
    }
  }
}
```

## Configuring VLANs to Direct Traffic onto the MACsec-Secured CCC

This section explains how to configure VLANs on the site A and site B CE routers. The purpose of the VLANs is to direct traffic that you want to be MACsec-secured onto the MACsec-secured CCC.

- [Configuring the Bridge Domain to Direct Traffic to the MACsec CCC on the Site A CE Router on page 112](#)
- [Configuring the Bridge Domain to Direct Traffic to the MACsec CCC on the Site B CE Router on page 113](#)

## Configuring the Bridge Domain to Direct Traffic to the MACsec CCC on the Site A CE Router

<b>CLI Quick Configuration</b>	<pre>[edit] set interfaces ge-0/0/0 unit 0 encapsulation vlan-bridge set interfaces ge-0/0/0 unit 0 family bridge set interfaces ge-0/0/2 unit 0 encapsulation vlan-bridge set interfaces ge-0/0/2 unit 0 family bridge set bridge-domains macsec vlan-id 50 set bridge-domains macsec domain-type bridge set bridge-domains macsec vlan-id all set bridge-domains macsec interface ge-0/0/0 set bridge-domains macsec interface ge-0/0/2 set interfaces irb vlan-id 50 family inet address 5.5.5.1/24</pre>
<b>Step-by-Step Procedure</b>	<p>To create a bridge domain (VLAN ID 50) that directs traffic from the user at site A onto the MACsec-secured CCC:</p>

1. Configure the ge-0/0/0 interface with VLAN encapsulation and the bridge family.

```
user@router-CE-A# set interfaces ge-0/0/0 unit 0 encapsulation vlan-bridge
user@router-CE-A# set interfaces ge-0/0/0 unit 0 family bridge vlan-id 50
```

2. Configure the ge-0/0/2 interface with VLAN encapsulation and the bridge family.

```
[edit]
user@router-CE-A#set interfaces ge-0/0/2 unit 0 encapsulation vlan-bridge
user@router-CE-A#set interfaces ge-0/0/2 unit 0 family bridge vlan-id 50
```

3. Define the macsec bridge domain and associate the interfaces, ge-0/0/0 and ge-0/0/2, with the bridge domain.

```
[edit]
user@router-CE-A# set bridge-domains macsec vlan-id 50
user@router-CE-A# set bridge-domains macsec domain-type bridge
user@router-CE-A# set bridge-domains macsec interface ge-0/0/0
user@router-CE-A# set bridge-domains macsec interface ge-0/0/2
```

4. Create the IP address for the macsec bridge domain:

```
[edit]
user@router-CE-A# set interfaces irb vlan-id 50 family inet address 5.5.5.1/24
```

**Results** Display the results of the configuration:

```
user@router-CE-A> show configuration
interfaces {
  ge-0/0/0 {
    unit 0 {
      encapsulation vlan-bridge;
      family bridge {
        vlan-id 50;
      }
    }
  }
  ge-0/0/2 {
    unit 0 {
      encapsulation vlan-bridge;
      family bridge {
        vlan-id 50;
      }
    }
  }
}
```

```

    }
  }
}
irb {
  vlan-id 50 {
    family inet address 5.5.5.1/24;
  }
}
}
bridge-domains {
  macsec {
    domain-type bridge;
    vlan-id 50;
    interface ge-0/0/0;
    interface ge-0/0/2;
  }
}
}

```

### Configuring the Bridge Domain to Direct Traffic to the MACsec CCC on the Site B CE Router

#### CLI Quick Configuration

```

[edit]
set interfaces xe-0/1/0 unit 0 encapsulation vlan-bridge
set interfaces xe-0/1/0 unit 0 family bridge
set interfaces ge-0/0/2 unit 0 encapsulation vlan-bridge
set interfaces ge-0/0/2 unit 0 family bridge
set bridge-domains macsec vlan-id 50
set bridge-domains macsec domain-type bridge
set bridge-domains macsec vlan-id all
set bridge-domains macsec interface ge-0/0/2
set bridge-domains macsec interface xe-0/1/0
set interfaces irb vlan-id 50 family inet address 5.5.5.2/24

```

#### Step-by-Step Procedure

To create a bridge domain (VLAN ID 50) to direct traffic for the user at site B onto the MACsec-secured CCC:

1. Configure the xe-0/1/0 interface with VLAN encapsulation and the bridge family.

```

user@router-CE-A# set interfaces xe-0/1/0 unit 0 encapsulation vlan-bridge
user@router-CE-A# set interfaces xe-0/1/0 unit 0 family bridge vlan-id 50

```

2. Configure the ge-0/0/2 interface with VLAN encapsulation and the bridge family.

```

[edit]
user@router-CE-A# set interfaces ge-0/0/2 unit 0 encapsulation vlan-bridge
user@router-CE-A# set interfaces ge-0/0/2 unit 0 family bridge vlan-id 50

```

3. Define the macsec bridge domain and associate the interfaces, xe-0/1/0 and ge-0/0/2, with the bridge domain.

```

[edit]
user@router-CE-A# set bridge-domains macsec vlan-id 50
user@router-CE-A# set bridge-domains macsec domain-type bridge
user@router-CE-A# set bridge-domains macsec interface xe-0/1/0
user@router-CE-A# set bridge-domains macsec interface ge-0/0/2

```

4. Create the IP address for the macsec bridge domain:

```

[edit]
user@router-CE-A# set interfaces irb vlan-id 50 family inet address 5.5.5.2/24

```

**Results** Display the results of the configuration:

```
user@router-CE-B> show configuration
interfaces {
  ge-0/0/2 {
    unit 0 {
      encapsulation vlan-bridge;
      family bridge {
        vlan-id 50;
      }
    }
  }
  xe-0/1/0 {
    unit 0 {
      encapsulation vlan-bridge;
      family bridge {
        vlan-id 50;
      }
    }
  }
  irb {
    vlan-id 50 {
      family inet address 5.5.5.2/24;
    }
  }
}
bridge-domains {
  macsec {
    domain-type bridge;
    vlan-id 50;
    interface xe-0/1/0;
    interface ge-0/0/2;
  }
}
```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying the MACsec Connection on page 114](#)
- [Verifying That MACsec-Secured Traffic Is Traversing the CCCs on page 115](#)
- [Verifying That the MPLS and CCC Protocols Are Enabled on the Provider Edge and Provider Switch Interfaces on page 116](#)
- [Verifying MPLS Label Operations on page 117](#)
- [Verifying the Status of the MPLS CCCs on page 117](#)
- [Verifying OSPF Operation on page 118](#)
- [Verifying the Status of the RSVP Sessions on page 118](#)

---

### Verifying the MACsec Connection

**Purpose** Verify that MACsec is operational on the CCC.

**Action** Enter the **show security macsec connections** command on one or both of the customer edge (CE) switches.

```
user@router-CE-A> show security macsec connections
Interface name: ge-0/0/0
  CA name: ccc-macsec
  Cipher suite: GCM-AES-128   Encryption: on
  Key server offset: 0       Include SCI: no
  Replay protect: off        Replay window: 0
  Outbound secure channels
    SC Id: 00:19:E2:53:CD:F3/1
    Outgoing packet number: 9785
  Secure associations
    AN: 0 Status: inuse Create time: 2d 20:47:54
  Inbound secure channels
    SC Id: 00:23:9C:0A:53:33/1
  Secure associations
    AN: 0 Status: inuse Create time: 2d 20:47:54
```

**Meaning** The **Interface name:** and **CA name:** outputs shows that the ccc-macsec connectivity association is operational on interface ge-0/0/0. The output does not appear when the connectivity association is not operational on the interface.

For additional verification that MACsec is operational on the CCC, you can also enter the **show security macsec connections** command on the other CE switch.

### Verifying That MACsec-Secured Traffic Is Traversing the CCCs

**Purpose** Verify that traffic traversing the CCC is MACsec-secured.

**Action** Enter the **show security macsec statistics** command on one or both of the CE switches.

```
user@router-CE-A> show security macsec statistics
Interface name: ge-0/0/0
  Secure Channel transmitted
    Encrypted packets: 9784
    Encrypted bytes:   2821527
    Protected packets: 0
    Protected bytes:   0
  Secure Association transmitted
    Encrypted packets: 9784
    Protected packets: 0
  Secure Channel received
    Accepted packets: 9791
    Validated bytes:  0
    Decrypted bytes:  2823555
  Secure Association received
    Accepted packets: 9791
    Validated bytes:  0
    Decrypted bytes:  2823555
```

**Meaning** The **Encrypted packets** line under the **Secure Channel transmitted** output is incremented each time a packet is sent from the interface that is secured and encrypted by MACsec. The **Encrypted packets** output shows that 9784 encrypted and secured packets have been transmitted from interface ge-0/0/0. MACsec-secured traffic is, therefore, being sent on interface ge-0/0/0.

The **Accepted packets** line under the **Secure Association received** output is incremented each time a packet that has passed the MACsec integrity check is received on the interface. The **Decrypted bytes** line under the **Secure Association received** output is incremented each time an encrypted packet is received and decrypted. The output shows that 9791 MACsec-secured packets have been received on interface ge-0/0/0, and that 2823555 bytes from those packets have been successfully decrypted. MACsec-secured traffic is, therefore, being received on interface ge-0/0/0.

For additional verification, you can also enter the **show security macsec statistics** command on the other CE switch.

### Verifying That the MPLS and CCC Protocols Are Enabled on the Provider Edge and Provider Switch Interfaces

**Purpose** Verify that MPLS is enabled on the correct interfaces for the PE and provider switches.

**Action** Enter the **show interfaces terse** command on both of the PE routers and the provider switch:

```
user@router-PE1> show interfaces terse
Interface      Admin Link Proto  Local          Remote
ge-0/0/0       up    up
ge-0/0/0.0     up    up    ccc
ge-0/0/1       up    up
ge-0/0/1.0     up    up    inet    10.1.5.2/24
                                     mpls
<some output removed for brevity>
```

```
user@router-P> show interfaces terse
Interface      Admin Link Proto  Local          Remote
xe-0/0/0       up    up
xe-0/0/0.0     up    up    inet    10.1.9.1/24
                                     mpls
ge-0/0/10      up    up
ge-0/0/10.0    up    up    inet    10.1.5.1/24
                                     mpls
<some output removed for brevity>
```

```
user@router-PE2> show interfaces terse
Interface      Admin Link Proto  Local          Remote
xe-0/1/0       up    up
xe-0/1/0.0     up    up    inet    10.1.9.2/24
                                     mpls
xe-0/1/1       up    up
xe-0/1/1.0     up    up    ccc
<some output removed for brevity>
```

**Meaning** The output confirms that the MPLS protocol is up for the provider switch interfaces passing MPLS traffic—xe-0/0/0 and ge-0/0/10—and on the PE router interfaces passing MPLS traffic, which is interface ge-0/0/1 on the PE1 switch and interface xe-0/1/0 on the PE2 router.

The output also confirms that CCC is enabled on the PE router interfaces facing the CE switches, which are interface ge-0/0/0 on the PE1 switch and interface xe-0/1/1 on the PE2 router.



### Verifying MPLS Label Operations

**Purpose** Verify which interface is being used as the beginning of the CCC and which interface is being used to push the MPLS packet to the next hop.

**Action** Enter the **show route forwarding-table family mpls** on one or both of the PE routers.

```
user@router-PE1> show route forwarding-table family mpls
```

```
Routing table: default.mpls
MPLS:
Destination      Type RtRef Next hop      Type Index NhRef Netif
default          perm  0          Type Index NhRef Netif
0                user  0          recv  49    4
1                user  0          recv  49    4
2                user  0          recv  49    4
13               user  0          recv  49    4
299856           user  0          Pop   1327   2 ge-0/0/0.0
ge-0/0/0.0 (CCC) user  0 10.1.5.1 Push 299952 1328 2 ge-0/0/1.0
```

**Meaning** This output confirms that the CCC is configured on interface ge-0/0/0.0. The switch receives ingress traffic on ge-0/0/1.0 and pushes label 299952 onto the packet, which exits the switch through interface ge-0/0/1.0. The output also shows that when the switch receives an MPLS packet with label 299856, it pops the label and sends the packet out through interface ge-0/0/0.0

For further verification of MPLS label operations, enter the **show route forwarding-table family mpls** on the other PE router.

### Verifying the Status of the MPLS CCCs

**Purpose** Verify that the MPLS CCCs are operating.

**Action** Enter the **show connections** command on the PE routers.

```
user@router-PE1> show connections
```

```
CCC and TCC connections [Link Monitoring On]
```

```
Legend for status (St):
```

```
UN -- uninitialized
NP -- not present
WE -- wrong encapsulation
DS -- disabled
Dn -- down
-> -- only outbound conn is up
<- -- only inbound conn is up
Up -- operational
RmtDn -- remote CCC down
Restart -- restarting
```

```
Legend for connection types:
```

```
if-sw: interface switching
rmt-if: remote interface switching
lsp-sw: LSP switching
tx-p2mp-sw: transmit P2MP switching
rx-p2mp-sw: receive P2MP switching
```

```
Legend for circuit types:
```

```
intf -- interface
oif -- outgoing interface
tlsp -- transmit LSP
rlsp -- receive LSP
```

Connection/Circuit	Type	St	Time last up	# Up trans
ge-1-to-pe2	rmt-if	Up	May 30 19:01:45	1
ge-0/0/0.0	intf	Up		
lsp_to_pe2_xe1	tlsp	Up		
lsp_to_pe1_ge0	rlsp	Up		

```
user@router-PE2> show connections
```

```
CCC and TCC connections [Link Monitoring On]
```

```
Legend for status (St):
```

```
UN -- uninitialized
NP -- not present
WE -- wrong encapsulation
DS -- disabled
Dn -- down
-> -- only outbound conn is up
<- -- only inbound conn is up
Up -- operational
RmtDn -- remote CCC down
Restart -- restarting
```

```
Legend for connection types:
```

```
if-sw: interface switching
rmt-if: remote interface switching
lsp-sw: LSP switching
tx-p2mp-sw: transmit P2MP switching
rx-p2mp-sw: receive P2MP switching
```

```
Legend for circuit types:
```

```
intf -- interface
oif -- outgoing interface
tlsp -- transmit LSP
rlsp -- receive LSP
```

Connection/Circuit	Type	St	Time last up	# Up trans
xe-1-to-pe1	rmt-if	Up	May 30 09:39:15	1
xe-0/1/1.0	intf	Up		
lsp_to_pe1_ge0	tlsp	Up		
lsp_to_pe2_xe1	rlsp	Up		

The **show connections** command displays the status of the CCC connections. This output verifies that the CCC interfaces and their associated transmit and receive LSPs are **Up** on both PE routers.

### Verifying OSPF Operation

**Purpose** Verify that OSPF is running.

**Action** Enter the **show ospf neighbor** command the provider or the PE routers, and check the **State** output.

```
user@router-P> show ospf neighbor
```

Address	Interface	State	ID	Pri	Dead
10.1.5.2	ge-0/0/10.0	Full	130.1.1.1	128	33
10.1.9.2	xe-0/0/0.0	Full	130.1.1.3	128	38

**Meaning** The **State** output is **Full** on all interfaces using OSPF, so OSPF is operating.

For further verification on OSPF, enter the **show ospf neighbor** command on the PE routers in addition to the provider switch.

### Verifying the Status of the RSVP Sessions

**Purpose** Verify the status of the RSVP sessions.

**Action** Enter the **show rsvp session** command, and verify that the state is up for each RSVP session.

```
user@router-P> show rsvp session
```

```
Ingress RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

```
Egress RSVP: 0 sessions
```

```
Total 0 displayed, Up 0, Down 0
```

```
Transit RSVP: 2 sessions
```

To	From	State	Rt	Style	Labelin	Labelout	LSPname
130.1.1.1	130.1.1.3	Up	0	1 FF	299936	299856	lsp_to_pe1_ge0
130.1.1.3	130.1.1.1	Up	0	1 FF	299952	299840	lsp_to_pe2_xe1

```
Total 2 displayed, Up 2, Down 0
```

**Meaning** The **State** is **Up** for all connections, so RSVP is operating normally.

For further verification, enter the **show rsvp session** on the PE routers in addition to the provider router.



## CHAPTER 8

# Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy

- [Aggregated Ethernet Interfaces Overview on page 122](#)
- [Configuring an Aggregated Ethernet Interface on page 126](#)
- [Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 128](#)
- [Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 129](#)
- [Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136](#)
- [Example: Configuring Aggregated Ethernet Interfaces on page 139](#)
- [Configuring Junos OS for Supporting Aggregated Devices on page 140](#)
- [Configuring the Number of Aggregated Ethernet Interfaces on the Device on page 143](#)
- [Configuring Aggregated Ethernet Link Speed on page 144](#)
- [Configuring Aggregated Ethernet Minimum Links on page 145](#)
- [Configuring Tagged Aggregated Ethernet Interfaces on page 146](#)
- [Configuring Untagged Aggregated Ethernet Interfaces on page 147](#)
- [Configuring LACP for Aggregated Ethernet Interfaces on page 148](#)
- [Configuring Aggregated Ethernet Link Protection on page 156](#)
- [Example: Configuring Aggregated Ethernet Link Protection on page 158](#)
- [Configuring Shared Scheduling on Aggregated Ethernet Interfaces on page 158](#)
- [Configuring Scheduler on Aggregated Ethernet Interfaces Without Link Protection on page 159](#)
- [Configuring Symmetrical Load Balancing on an 802.3ad Link Aggregation Group on MX Series Routers on page 160](#)
- [Understanding Aggregated Ethernet Load Balancing on page 166](#)
- [Example: Configuring Aggregated Ethernet Load Balancing on page 168](#)
- [Stateful Load Balancing for Aggregated Ethernet Interfaces Using 5-Tuple Data on page 184](#)

- [Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187](#)
- [Configuring Adaptive Load Balancing on page 188](#)
- [Understanding Independent Micro BFD Sessions for LAG on page 189](#)
- [Example: Configuring Independent Micro BFD Sessions for LAG on page 192](#)
- [Configuring Multicast Statistics Collection on Aggregated Ethernet Interfaces on page 201](#)
- [Deleting an Aggregated Ethernet Interface on page 202](#)
- [Configuring Distributed Periodic Packet Management on page 202](#)

## Aggregated Ethernet Interfaces Overview

---

Link aggregation of Ethernet interfaces is defined in the IEEE 802.3ad standard. The Junos OS implementation of 802.3ad balances traffic across the member links within an aggregated Ethernet bundle based on the Layer 3 information carried in the packet. This implementation uses the same load-balancing algorithm used for per-flow load balancing.



**NOTE:** For information about configuring circuit cross-connects over aggregated Ethernet, see *Circuit and Translational Cross-Connects Overview*.

For information about mixed rates and mixed modes on an aggregated Ethernet bundle, see [“Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles” on page 129](#).

## Platform Support for Aggregated Ethernet Interfaces

You configure an aggregated Ethernet virtual link by specifying the link number as a physical device and then associating a set of ports that have the same speed and are in full-duplex mode. The physical interfaces can be Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ, Gigabit Ethernet IQ2 and IQ2-E, or 10-Gigabit Ethernet IQ2 and IQ2-E. Generally, you cannot use a combination of these interfaces within the same aggregated link; however, you can combine Gigabit Ethernet and Gigabit Ethernet IQ interfaces in a single aggregated Ethernet bundle.

Starting with Junos OS Release 13.2, aggregated Ethernet supports the following mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers:

- Member links of different modes (WAN and LAN) for 10-Gigabit Ethernet links.
- Member links of different rates: 10-Gigabit Ethernet, 40-Gigabit Ethernet, 50-Gigabit Ethernet, 100-Gigabit Ethernet, and OC192 (10-Gigabit Ethernet WAN mode)

**NOTE:**

- Member links of 50-Gigabit Ethernet can only be configured using the 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
- Starting with Junos OS Release 13.2, 100-Gigabit Ethernet member links can be configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP. This 100-Gigabit Ethernet member link can be included in an aggregated Ethernet link that includes member links of other interfaces as well. In releases before Junos OS Release 13.2, the 100-Gigabit Ethernet member link configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP cannot be included in an aggregated Ethernet link that includes member links of other interfaces.

**TIP:****Going forward:**

- Aggregated Ethernet link with member links of different modes will be referred as *10-Gigabit Ethernet mixed mode aggregated Ethernet link*.
- Aggregated Ethernet link with member links of different rates will be referred as *mixed rate aggregated Ethernet link*.
- These aggregated Ethernet links will generically be referred as *mixed aggregated Ethernet links*.

Table 11 on page 123 lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.

**Table 11: Platform Support Matrix for Mixed Aggregated Ethernet Bundles**

Rate and Mode	Supported Platform	Supported FPCs	Supported PICs
10-Gigabit Ethernet LAN and WAN  (WAN rate: OC192)	T640, T1600, T4000, and TX Matrix Plus routers	• T4000 FPC5 (T4000-FPC5-3D)	• 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (PF-24XGE-SFPP) • 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP)
		• Enhanced Scaling FPC3 (T640-FPC3-ES)	• 10-Gigabit Ethernet PIC with XENPAK (PC-1XGE-XENPAK)
		• Enhanced Scaling FPC4 (T640-FPC4-ES)	• 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP)
		• Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES) • T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)	• 10-Gigabit Ethernet LAN/WAN PIC with XFP (PD-4XGE-XFP)

Table 11: Platform Support Matrix for Mixed Aggregated Ethernet Bundles (*continued*)

Rate and Mode	Supported Platform	Supported FPCs	Supported PICs
40-Gigabit Ethernet, 100-Gigabit Ethernet	T4000 and TX Matrix Plus routers	<ul style="list-style-type: none"> <li>T4000 FPC5 (T4000-FPC5-3D)</li> </ul>	<ul style="list-style-type: none"> <li>100-Gigabit Ethernet PIC with CFP (PF-1CGE-CFP)</li> </ul>
	T640, T1600, T4000, and TX Matrix Plus routers	<ul style="list-style-type: none"> <li>Enhanced Scaling FPC4 (T640-FPC4-ES)</li> <li>Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)</li> <li>T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</li> </ul>	<ul style="list-style-type: none"> <li>100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4)</li> <li><b>NOTE:</b> This PIC is available packaged only in an assembly with the T1600-FPC4-ES FPC.</li> <li>40-Gigabit Ethernet PIC with CFP (PD-1XLE-CFP)</li> </ul>

All Juniper routers support at least eight physical interfaces per aggregated Ethernet bundle. See [maximum-links](#) configuration page for platform specific limits.

On M Series and T Series routers, you can create a maximum of 1024 logical interfaces on an aggregated Ethernet interface.

Aggregated Ethernet interfaces can use interfaces from different FPCs, DPCs, PICs, or MPCs.

## Configuration Guidelines for Aggregated Ethernet Interfaces

- Simple filters are not supported for interfaces in aggregated Ethernet bundles:
  - On M Series routers, simple filters are supported in Gigabit Ethernet Enhanced Intelligent Queuing interfaces only, except when the interface is part of an aggregated Ethernet bundle.
  - On MX Series routers, simple filters are supported in Enhanced Queuing Dense Port Concentrator (EQ DPC) interfaces only, except when the interface is part of an aggregated Ethernet bundle.

For more information about simple filters, see the *Class of Service Feature Guide for Routing Devices*.

- On the aggregated Ethernet bundle, no IQ-specific capabilities such as MAC accounting, VLAN rewrites, and VLAN queuing are available. For more information about IQ-specific capabilities, see [“Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs” on page 455](#).
- Aggregated Ethernet interfaces can be either tagged or untagged, with LACP enabled or disabled. Aggregated Ethernet interfaces on MX Series routers support the configuration of **flexible-vlan-tagging** and **native-vlan-id** on dual-tagged frames, which consist of the following configuration statements:
  - inner-tag-protocol-id**
  - inner-vlan-id**



- [pop-pop](#)
- [pop-swap](#)
- [push-push](#)
- [swap-push](#)
- [swap-swap](#)

In all cases, you must set the number of aggregated Ethernet interfaces on the chassis. You can also set the link speed and the minimum links in a bundle.

- When configuring mixed aggregated Ethernet bundles on T640, T1600, T4000, and TX Matrix Plus routers, consider the following:
  - A maximum of 16 member links can be configured to form a mixed aggregated Ethernet link.
  - Link Aggregation Control Protocol (LACP), aggregated Ethernet link protection, and LACP link protection are supported only on mixed aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
  - Traffic distribution is based on the hash calculated on the egress packet header. Hash range is fairly distributed according to member links' speed. This guarantees hash fairness but it does not guarantee fair traffic distribution depending on the rate of the egress streams.
  - Packets are dropped when the total throughput of the hash flow exiting a member link (or multiple hash flows exiting a single member link) exceeds the link speed of the member link. This can happen when egress member link changes because of a link failure and the hash flow switches to a member link of speed that is less than the total throughput of the hash flow.
  - Rate-based CoS components such as scheduler, shaper, and policer are not supported on mixed rate aggregated Ethernet links. However, the default CoS settings are supported by default on the mixed rate aggregated Ethernet links.
  - Load balancing is performed at the ingress Packet Forwarding Engine. Therefore, you must ensure that the egress traffic on the aggregated Ethernet link enters through the hardware platforms that support mixed aggregated Ethernet bundles. [Table 11 on page 123](#) lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.
  - Mixed aggregated Ethernet links can interoperate with non-Juniper Networks aggregated Ethernet member links provided that mixed aggregated Ethernet load balancing is configured at egress.
  - Load balancing of the egress traffic across the member links of a mixed rate aggregated Ethernet link is proportional to the rates of the member links.
  - Egress multicast load balancing is not supported on mixed aggregated Ethernet interfaces.
  - Changing the `edit interfaces aex aggregated-ether-options link-speed` configuration of a mixed aggregated Ethernet link, which is configured on the supported interfaces

of on T640, T1600, T4000, and TX Matrix Plus routers, leads to aggregated Ethernet link flapping.

- When configuring a mixed aggregated Ethernet link on a 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4), ensure that you add both the 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP to the aggregated Ethernet bundle. Moreover, both these 50-Gigabit Ethernet interfaces must be included in the same aggregated Ethernet bundle.
- When a mixed aggregated Ethernet link is configured on a 100-Gigabit Ethernet PIC with CFP, changing aggregated Ethernet link protection or LACP link protection configurations leads to aggregated Ethernet link flapping.
- For a single physical link event of an aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC with CFP, the packet loss performance value is twice the original value because of the two 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP.
- The **show interfaces aex** command displays the link speed of the aggregated Ethernet interface, which is the sum of the link speeds of all the active member links.
- Use the **show interfaces aggregate-interface extensive** and **show interfaces aggregate.logical-interface** commands to show the bandwidth of the aggregate. Also, the SNMP object identifier **ifSpeed/ifHighSpeed** shows the corresponding bandwidth on the aggregate logical interface if it is configured properly.

**Related  
Documentation**

- [inner-tag-protocol-id on page 995](#)
- [inner-vlan-id on page 996](#)
- [pop-pop on page 1119](#)
- [pop-swap on page 1120](#)
- [push-push on page 1140](#)
- [swap-push on page 1193](#)
- [swap-swap on page 1194](#)
- [Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136](#)
- [Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 455](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 129](#)

---

## Configuring an Aggregated Ethernet Interface

On Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces on M Series and T Series routers, you can associate a physical interface with an aggregated Ethernet interface.



**NOTE:** On a Junos Fusion, you can include extended ports (physical interface on a satellite device that provides a connection to servers or endpoints) or local ports in link aggregation groups (LAGs) and MC-LAGs, but not both. For information on extended ports, see *Understanding Junos Fusion Ports*.

To configure an aggregated Ethernet interface:

1. Specify that you want to configure the link aggregation group interface.

```
user@host# edit interfaces interface-name
```

2. Configure the aggregated Ethernet interface.

```
[edit interfaces interface-name]  
user@host# set (fastether-options | gigether-options) 802.3ad aex
```

You specify the interface instance number *x* to complete the link association; *x* can be from 0 through 127, for a total of 128 aggregated interfaces on M Series and T Series routers and can be from 1 through 480, for a total of 480 aggregated interfaces on MX Series routers. For MX Series routers running Junos release 14.2R3 and later you can configure a maximum of 1000 aggregated interfaces. Aggregated interfaces are numbered from **ae0** through **ae4092**.



**NOTE:** On MX2010 and MX2020 routers you can configure a maximum of 800 aggregated interfaces.

You must also include a statement defining **aex** at the **[edit interfaces]** hierarchy level. You can optionally specify other physical properties that apply specifically to the aggregated Ethernet interfaces; for details, see “[Ethernet Interfaces Overview](#)” on page 3, and for a sample configuration, see “[Example: Configuring Aggregated Ethernet Interfaces](#)” on page 139.



**NOTE:** In general, aggregated Ethernet bundles support the features available on all supported interfaces that can become a member link within the bundle. As an exception, Gigabit Ethernet IQ features and some newer Gigabit Ethernet features are not supported in aggregated Ethernet bundles.

Gigabit Ethernet IQ and SFP interfaces can be member links, but IQ- and SFP-specific features are not supported on the aggregated Ethernet bundle even if all the member links individually support those features.

You need to configure the correct link speed for the aggregated Ethernet interface to eliminate any warning message.



**NOTE:** Before you commit an aggregated Ethernet configuration, ensure that link mode is not configured on any member interface of the aggregated Ethernet bundle; otherwise, the configuration commit check fails.

**Related  
Documentation**

- [Configuring the Number of Aggregated Ethernet Interfaces on the Device on page 143](#)
- [Deleting an Aggregated Ethernet Interface on page 202](#)
- [Aggregated Ethernet Interfaces Overview on page 122](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers

IEEE 802.3ad link aggregation enables you to group Ethernet interfaces to form a single link layer interface, also known as a link aggregation group (LAG) or bundle. Link aggregation can be used for point-to-point connections. It balances traffic across the member links within an aggregated Ethernet bundle and effectively increases the uplink bandwidth. Another advantage of link aggregation is increased availability because the LAG is composed of multiple member links. If one member link fails, the LAG continues to carry traffic over the remaining links.

This topic describes how to configure aggregated Ethernet interfaces on PTX Series Packet Transport Routers.

On PTX Series Packet Transport Routers, aggregated Ethernet support includes the following features:

- A consistent interface type (*et fpc/pic/port*) across all Ethernet interfaces.
- Ability to bundle multiple Ethernet interfaces
- Ability to bundle mixed-rate links on the same aggregated Ethernet interface
- Fault tolerance
- Load balancing between child links
- Advanced features including flexible VLAN tagging and Ethernet services encapsulation

Aggregated Ethernet interfaces can use interfaces from different FPCs or PICs. The following configuration is sufficient to get an aggregated Gigabit Ethernet interface up and running.

```
[edit chassis]
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }

[edit interfaces]
  et-0/0/0 {
```

```
gigether-options {
  802.3ad ae0;
}
et-0/0/1 {
  gigether-options {
    802.3ad ae0;
  }
}
ae0 {
  vlan-tagging;
  unit 0 {
    vlan-id 100;
    family inet {
      address 200.200.1.2/24;
    }
  }
  unit 1 {
    vlan-id 101;
    family inet {
      address 200.200.2.2/24;
    }
  }
}
```

**Related  
Documentation**

- [Aggregated Ethernet Interfaces Overview on page 122](#)
- [Configuring Junos OS for Supporting Aggregated Devices on page 140](#)
- [Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136](#)

---

## Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles

You can configure the member links of an aggregated Ethernet bundle with any combination of rates—also known as mixed rates—on T Series, MX Series, and PTX Series routers. The bandwidth that is provided by an aggregated Ethernet bundle can be utilized completely and efficiently when the links are configured with different rates.

You can configure mixed modes on T Series routers. In a mixed-mode configuration, the member links of an aggregated Ethernet bundle are configured in LAN mode as well as in WAN mode for 10-Gigabit Ethernet interfaces.

The following sections provide an overview about mixed rates and mixed modes on various platforms:

- [Supported Platforms on page 130](#)
- [Aggregated Ethernet Bundle with Mixed Rates and Mixed Modes on T Series Routers on page 130](#)
- [Aggregated Ethernet Bundles with Mixed Rates on MX Series Routers on page 133](#)

## Supported Platforms

[Table 12 on page 130](#) summarizes the first Junos OS release that supports aggregated Ethernet bundles on the various Juniper Networks routers and their components:

**Table 12: Mixed Rates and Mixed Modes Support on Junos OS**

Supported Platforms	Junos OS Release
Mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers	13.2
Mixed rates on MX240, MX480, MX960, MX2010, and MX2020 routers	14.1R2 14.2
Mixed rates on PTX Series Packet Transport Routers	14.2
Mixed rates on P2-10G-40G-QSFPP PIC and P2-100GE-OTN PIC on PTX5000 routers	15.1

## Aggregated Ethernet Bundle with Mixed Rates and Mixed Modes on T Series Routers

The following sections explain mixed rates and mixed modes on T Series routers:

- [Understanding Mixed Rates and Mixed Modes on page 130](#)
- [Platform Support Matrix for Mixed Aggregated Ethernet Bundles on page 131](#)
- [Guidelines to Follow When Configuring Aggregated Ethernet Bundles with Mixed Rates and Mixed Modes on page 132](#)

### Understanding Mixed Rates and Mixed Modes

Starting with Junos OS Release 13.2, aggregated Ethernet supports the following mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers:

- Member links of different modes (WAN and LAN) for 10-Gigabit Ethernet links.
- Member links of different rates: 10-Gigabit Ethernet, 40-Gigabit Ethernet, 50-Gigabit Ethernet, 100-Gigabit Ethernet, and OC192 (10-Gigabit Ethernet WAN mode)

**NOTE:**

- Member links of 50-Gigabit Ethernet can only be configured using the 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
- Starting with Junos OS Release 13.2, 100-Gigabit Ethernet member links can be configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP. This 100-Gigabit Ethernet member link can be included in an aggregated Ethernet link that includes member links of other interfaces as well.

In releases before Junos OS Release 13.2, the 100-Gigabit Ethernet member link configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP cannot be included in an aggregated Ethernet link that includes member links of other interfaces.

**Going forward:**

- An aggregated Ethernet link with member links of different modes is referred to as *10-Gigabit Ethernet mixed-mode aggregated Ethernet link*.
- An aggregated Ethernet link with member links of different rates is referred to as *mixed-rate aggregated Ethernet link*.
- These aggregated Ethernet links will generically be referred to as *mixed aggregated Ethernet links*.

### Platform Support Matrix for Mixed Aggregated Ethernet Bundles

Table 11 on page 123 lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.

**Table 13: Platform Support Matrix for Mixed Aggregated Ethernet Bundles**

Rate and Mode	Supported Platform	Supported FPCs	Supported PICs
10-Gigabit Ethernet LAN and WAN  (WAN rate: OC192)	T640, T1600, T4000, and TX Matrix Plus routers	• T4000 FPC5 (T4000-FPC5-3D)	• 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (PF-24XGE-SFPP) • 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP)
		• Enhanced Scaling FPC3 (T640-FPC3-ES)	• 10-Gigabit Ethernet PIC with XENPAK (PC-1XGE-XENPAK)
		• Enhanced Scaling FPC4 (T640-FPC4-ES) • Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES) • T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)	• 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP) • 10-Gigabit Ethernet LAN/WAN PIC with XFP (PD-4XGE-XFP)

Table 13: Platform Support Matrix for Mixed Aggregated Ethernet Bundles (*continued*)

Rate and Mode	Supported Platform	Supported FPCs	Supported PICs
40-Gigabit Ethernet, 100-Gigabit Ethernet	T4000 and TX Matrix Plus routers	<ul style="list-style-type: none"> <li>T4000 FPC5 (T4000-FPC5-3D)</li> </ul>	<ul style="list-style-type: none"> <li>100-Gigabit Ethernet PIC with CFP (PF-1CGE-CFP)</li> </ul>
	T640, T1600, T4000, and TX Matrix Plus routers	<ul style="list-style-type: none"> <li>Enhanced Scaling FPC4 (T640-FPC4-ES)</li> <li>Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)</li> <li>T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</li> </ul>	<ul style="list-style-type: none"> <li>100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4)</li> <li><b>NOTE:</b> This PIC is available packaged only in an assembly with the T1600-FPC4-ES FPC.</li> <li>40-Gigabit Ethernet PIC with CFP (PD-1XLE-CFP)</li> </ul>

#### Guidelines to Follow When Configuring Aggregated Ethernet Bundles with Mixed Rates and Mixed Modes

In addition to the configuration guidelines for aggregated Ethernet interfaces in [“Aggregated Ethernet Interfaces Overview” on page 122](#), you must consider the following as well when configuring mixed modes and mixed rates on aggregated Ethernet bundles on T640, T1600, T4000, and TX Matrix Plus routers:

- A maximum of 16 member links can be configured to form a mixed aggregated Ethernet link.
- Link Aggregation Control Protocol (LACP), aggregated Ethernet link protection, and LACP link protection are supported only on mixed aggregated Ethernet bundles configured on a 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
- Traffic distribution is based on the hash calculated on the egress packet header. Hash range is fairly distributed according to member links' speed. This guarantees hash fairness but it does not guarantee fair traffic distribution depending on the rate of the egress streams.
- Packets are dropped when the total throughput of the hash flow exiting a member link (or multiple hash flows exiting a single member link) exceeds the link speed of the member link. This can happen when egress member link changes because of a link failure and the hash flow switches to a member link of speed that is less than the total throughput of the hash flow.
- Rate-based CoS components such as scheduler, shaper, and policer are not supported on mixed-rate aggregated Ethernet links. However, the default CoS settings are supported by default on the mixed-rate aggregated Ethernet links.
- Load balancing is performed at the ingress Packet Forwarding Engine. Therefore, you must ensure that the egress traffic on the aggregated Ethernet link enters through the hardware platforms that support mixed aggregated Ethernet bundles. [Table 11 on page 123](#) lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.



- Mixed aggregated Ethernet links can interoperate with non-Juniper Networks aggregated Ethernet member links provided that mixed aggregated Ethernet load balancing is configured at egress.
- Load balancing of the egress traffic across the member links of a mixed-rate aggregated Ethernet link is proportional to the rates of the member links.
- Egress multicast load balancing is not supported on mixed aggregated Ethernet interfaces.
- Changing the **[edit interfaces aex aggregated-ether-options link-speed]** configuration of a mixed aggregated Ethernet link, which is configured on the supported interfaces of on T640, T1600, T4000, and TX Matrix Plus routers, leads to aggregated Ethernet link flapping.
- When configuring a mixed aggregated Ethernet link on a 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4), ensure that you add both the 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP to the aggregated Ethernet bundle. Moreover, both these 50-Gigabit Ethernet interfaces must be included in the same aggregated Ethernet bundle.
- When a mixed aggregated Ethernet link is configured on a 100-Gigabit Ethernet PIC with CFP, changing aggregated Ethernet link protection or LACP link protection configurations leads to aggregated Ethernet link flapping.
- For a single physical link event of an aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC with CFP, the packet loss performance value is twice the original value because of the *two* 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP.
- The **show interfaces aex** command displays the link speed of the aggregated Ethernet interface, which is the sum of the link speeds of all the active member links.

## Aggregated Ethernet Bundles with Mixed Rates on MX Series Routers

The following sections explain mixed rates on aggregated Ethernet bundles:

- [Understanding Mixed Rates on page 133](#)
- [Supported Features on page 134](#)

### Understanding Mixed Rates

---

Starting with Junos OS Release 14.2, support for mixed rates on aggregated Ethernet bundles is extended to MX240, MX480, MX960, MX2010, and MX2020 routers, thereby enabling you to configure the member links with any combination of rates—10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet—on an aggregated Ethernet bundle.

You must configure the **mixed** statement explicitly at the **[edit interfaces interface-name aggregated-ether-options link-speed]** hierarchy level to:

- Enable the mixed-rate configuration on all the aggregated Ethernet bundles on the egress side of the Modular Port Concentrators (MPCs).

- Enable the router to detect child links of different speed values in the aggregated Ethernet bundle.

You can also configure the minimum bandwidth on an aggregated Ethernet bundle when you configure mixed rate on that aggregated Ethernet bundle.



**NOTE:** The minimum-link statement cannot be configured with mixed rates.

Mixed rates cannot be configured for aggregated Ethernet bundles on the egress side of the Dense Port concentrators (DPCs).

When you configure mixed rate on a homogeneous aggregated Ethernet bundle—where all the links in the bundle are of the same speed—the aggregated Ethernet bundle goes down and then comes up with the mixed-rate configuration.

---

### Supported Features

The following features are supported on mixed-rate aggregated Ethernet bundles on MX Series routers:

- Sixty-four links in a bundle.
- Load balancing of traffic in proportion to the member-link speed.
- Non link-protect mode. For more information, see [“Configuring Scheduler on Aggregated Ethernet Interfaces Without Link Protection” on page 159](#).
- LACP for slow and fast interval for periodic transmission of LACP packets.
- Port-based network access control (NAC).
- Scheduler parameters for aggregated interface member links in a scaled manner with the **member-link-scheduler scale** statement at the **[edit class-of-service interfaces]** hierarchy level.
- Layer 3 features only.
- Configuration of following statements as percentages only for mixed rates at the **[edit class-of-service schedulers *scheduler-name*]** hierarchy level:
  - **buffer-size**
  - **excess-rate**
  - **shaping-rate**
  - **transmit-rate**
- Configuration of the following statements for mixed rates at the **[edit class-of-service schedulers *scheduler-name*]** hierarchy level:
  - **drop-profile-map**
  - **excess-priority**

- **priority**
- **transmit-rate (rate-limit | exact)**
- The **shared-bandwidth-policer** statement at the **[edit firewall policer *policer-name*]** hierarchy level.
- The **scheduler-maps *map-name*** statement at the **[edit class-of-service]** hierarchy level.
- Unicast load balancing, where the load balancing happens on ingress-only selectors.
- Multicast load balancing
- Make-before-break (MBB) for multicast LDP (MLDP) and fast reroute (FRR).
- Source class usage (SCU) and destination class usage (DCU) accounting.
- Families **inet**, **inet6**, and **mpls**.
- Enhanced IP network services.
- LDP tunneling and OAM link fault management (LFM).

The following features are not supported on mixed-rate aggregated Ethernet bundles on MX Series routers:

- Adaptive load balancing
- Hierarchical schedulers on aggregated Ethernet bundles and the scheduling on logical interfaces (per-unit scheduling).
- Shaping rate, where traffic shaping is achieved by specifying the amount of bandwidth to be allocated to a logical interface.
- The **output-traffic-control-profile** statement at the **[edit class-of-service interfaces *interface-name*]** hierarchy level.
- Ingress queuing.
- Options that are configured with nonpercentage values at the **[edit class-of-service schedulers *scheduler-name*]** hierarchy level.
- The **member-link-scheduler replicate** statement at the **[edit class-of-service interfaces *interface-name*]** hierarchy level.
- Mixing LAN mode and WAN mode.
- Aggregated Ethernet link protection and link protection on a 1:1 model.
- LACP link protection.
- Layer 2 features.
- The **target-routing-instance (*routing-instance-name* | default)** statement at the **[edit access domain map *domain-map-name*]** hierarchy level.

#### Related Documentation

- [Aggregated Ethernet Interfaces Overview on page 122](#)
- [Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136](#)
- [minimum-bandwidth on page 1064](#)

- [P2-10G-40G-QSFPP PIC Overview on page 371](#)
- [Understanding the P2-100GE-OTN PIC on page 446](#)

## Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles

---

The following sections explain how to configure mixed rates and mixed modes on various platforms:

- [Configuring Mixed Rates and Mixed Modes on an Aggregated Ethernet Bundle on T Series Routers on page 136](#)
- [Configuring Mixed Rates on Aggregated Ethernet Bundles on MX Series Routers on page 138](#)

### Configuring Mixed Rates and Mixed Modes on an Aggregated Ethernet Bundle on T Series Routers

In releases before Junos OS Release 13.2, all interfaces that form an aggregated Ethernet bundle must have the same speed and must be in full-duplex mode. Starting with Junos OS Release 13.2, aggregated Ethernet supports the following mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers:

- Member links of different modes (WAN and LAN) for 10-Gigabit Ethernet links.
- Member links of different rates: 10-Gigabit Ethernet, 40-Gigabit Ethernet, 50-Gigabit Ethernet, 100-Gigabit Ethernet, and OC192 (10-Gigabit Ethernet WAN mode)



#### NOTE:

- Member links of 50-Gigabit Ethernet can be configured using only the 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
  - Starting with Junos OS Release 13.2, 100-Gigabit Ethernet member links can be configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP. This 100-Gigabit Ethernet member link can be included in an aggregated Ethernet link that includes member links of other interfaces as well. In releases before Junos OS Release 13.2, the 100-Gigabit Ethernet member link configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP cannot be included in an aggregated Ethernet link that includes member links of other interfaces.
- 

To configure member links of an aggregated Ethernet bundles in mixed rate or mixed mode on T640, T1600, T4000, and TX Matrix Plus routers:

1. Go to **[edit chassis]** hierarchy level.  

```
user@host# edit chassis
```
2. Configure the number of aggregated logical devices available to the router:

```
[edit chassis]
user@host# set aggregated-devices ethernet device-count number
```

3. Go to the **[edit interfaces]** hierarchy level.

```
user@host# top
user@host# edit interfaces
```

4. Configure the minimum number of links that are required for the aggregated Ethernet bundle to be labeled *up*:

```
[edit interfaces]
user@host# set aex aggregated-ether-options minimum-links number
```



**NOTE:** By default, only one link needs to be up for the bundle to be labeled *up*.

5. Configure the **link-speed** statement and specify the **mixed** option for the **link-speed** statement to indicate the mixed-rate and mixed-mode support for the aggregated Ethernet bundle configuration.

```
[edit interfaces]
user@host# set aex aggregated-ether-options link-speed mixed
```



**NOTE:** It is mandatory to configure the **mixed** option for aggregated Ethernet bundles for the PD-1CE-CFP-FPC4 PIC.

On aggregated Ethernet bundles in MX Series routers, when the **mixed** statement at the **[edit interfaces aex aggregated-ether-options link-speed]** hierarchy level is not configured, the mixed rate configuration is applied by default.

6. Configure the members links of the aggregated Ethernet bundle.

```
[edit interfaces]
user@host# set interface-name gigether-options 802.3ad aex
```

7. Configure an interface family and an IP address for the aggregated Ethernet bundle.

```
[edit interfaces]
user@host# set aex unit number family (inet | inet6 | mpls ) address address
```

8. Commit the configuration.

```
[edit interfaces]
user@host# commit
```

## Configuring Mixed Rates on Aggregated Ethernet Bundles on MX Series Routers

Starting with Junos OS Release 14.1R1 and 14.2, support for mixed rates on aggregated Ethernet bundles is extended to MX240, MX480, MX960, MX2010, and MX2020 routers, thereby enabling you to configure the member links with any combination of rates—10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet—on an aggregated Ethernet bundle.

To configure mixed rates on an aggregated Ethernet bundle on MX Series routers:

1. Go to the **[edit chassis]** hierarchy level.

```
user@host# edit chassis
```

2. Configure the number of aggregated logical devices available to the router.

```
[edit chassis]
user@host# set aggregated-devices ethernet device-count number
```

3. Go to the **[edit interfaces]** hierarchy level.

```
user@host# top
user@host# edit interfaces
```

4. Configure the **link-speed** statement and specify the **mixed** option for the **link-speed** statement to indicate the mixed-rate support for the aggregated Ethernet bundle configuration.

```
[edit interfaces]
user@host# set aex aggregated-ether-options link-speed mixed
```

5. Configure the members links of the aggregated Ethernet bundle:

```
[edit interfaces]
user@host# set interface-name gigether-options 802.3ad aex
```

6. Configure an interface family for the aggregated Ethernet bundle as **inet**, **inet6**, or **mpls**:

```
[edit interfaces]
user@host# set aex unit number family (inet | inet6 | mpls)
```

7. Configure the minimum bandwidth unit as **bps**, **gbps**, **kbps**, or **mbps** and the bandwidth value from 1 through 128,000.

```
[edit interfaces]
user@host# set aex aggregated-ether-options minimum-bandwidth bw-unit (bps |
gbps | kbps | mbps)
user@host# set aex aggregated-ether-options minimum-bandwidth bw-value value
```

8. Commit the configuration.

```
[edit interfaces]
user@host# commit
```

### Related Documentation

- [Aggregated Ethernet Interfaces Overview on page 122](#)
- [Configuring Aggregated Ethernet Link Speed on page 144](#)

- [Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 128](#)
- [link-speed on page 1029](#)
- [minimum-bandwidth on page 1064](#)
- [Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 129](#)

---

## Example: Configuring Aggregated Ethernet Interfaces

Aggregated Ethernet interfaces can use interfaces from different FPCs, DPCs, or PICs. The following configuration is sufficient to get an aggregated Gigabit Ethernet interface up and running.

```
[edit chassis]
aggregated-devices {
  ethernet {
    device-count 15;
  }
}

[edit interfaces]
ge-1/3/0 {
  gigether-options {
    802.3ad ae0;
  }
}
ge-2/0/1 {
  gigether-options {
    802.3ad ae0;
  }
}
ae0 {
  aggregated-ether-options {
    link-speed 1g;
    minimum-links 1;
  }
}
vlan-tagging;
unit 0 {
  vlan-id 1;
  family inet {
    address 14.0.100.50/24;
  }
}
unit 1 {
  vlan-id 1024;
  family inet {
    address 14.0.101.50/24;
  }
}
unit 2 {
  vlan-id 1025;
```

```
family inet {
    address 14.0.102.50/24;
}
unit 3 {
    vlan-id 4094;
    family inet {
        address 14.0.103.50/24;
    }
}
```

- Related Documentation**
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
  - [Configure 'link-speed' for Gigabit Ethernet based Aggregate Ethernet interface bundles](#)

---

## Configuring Junos OS for Supporting Aggregated Devices

Junos OS supports the aggregation of physical devices into defined virtual links, such as the link aggregation of Ethernet interfaces defined by the IEEE 802.3ad standard.

Tasks for configuring aggregated devices are:

- [Configuring Virtual Links for Aggregated Devices on page 140](#)
- [Configuring LACP Link Protection at the Chassis Level on page 141](#)
- [Enabling LACP Link Protection on page 141](#)
- [Configuring System Priority on page 142](#)
- [Configuring the Maximum Links Limit on page 142](#)
- [Configuring PPM on Junos Fusion on page 142](#)

### Configuring Virtual Links for Aggregated Devices

To define virtual links, you need to specify the associations between physical and logical devices within the **[edit interfaces]** hierarchy, and assign the correct number of logical devices by including the **device-count** statement at the **[edit chassis aggregated-devices ethernet]** and **[edit chassis aggregated-devices sonet]** hierarchy levels:

```
[edit chassis]
aggregated-devices {
    ethernet {
        device-count number;
    }
    sonet {
        device-count number;
    }
}
```

For M Series and T Series routers you can configure a maximum of 128 aggregated interfaces (LAG bundles). On MX Series routers running Junos release 14.2R2 and earlier, you can configure a maximum of 480 aggregated interfaces. For MX Series routers running Junos release 14.2R3 and later you can configure a maximum of 1000 aggregated interfaces. For MX2010 and MX2020 routers you can configure a maximum of 800



aggregated interfaces. In all cases the aggregated interfaces are numbered from **ae0** through **ae4091**.

For SONET/SDH, starting with Junos OS Release 13.2, the maximum number of logical interfaces is 64, numbered from **as0** through **as63**. In releases before Junos OS Release 13.2, the maximum was 16.

## Configuring LACP Link Protection at the Chassis Level

Link Aggregation Control Protocol (LACP) is one method of bundling several physical interfaces to form one logical interface. You can configure both VLAN-tagged and untagged aggregated Ethernet with or without LACP enabled. LACP exchanges are made between actors and partners. An actor is the local interface in an LACP exchange. A partner is the remote interface in an LACP exchange.

LACP link protection enables you to force active and standby links within an aggregated Ethernet. You configure LACP link protection by using the **link-protection** and **system-priority** statements at either the chassis or interface level and by configuring port priority at the interface level using the **system-priority** statement. Configuring LACP parameters at the chassis level results in all aggregated Ethernet interfaces using the defined values unless overridden by the LACP configuration on a specific interface.

```
[edit chassis]
aggregated-devices {
  ethernet {
    lacp {
      link-protection {
        non-revertive;
      }
      system-priority priority;
    }
  }
}
```



**NOTE:** LACP link protection also uses port priority. You can configure port priority at the Ethernet interface **[gigether-options]** hierarchy level using the **port-priority** statement. If you choose not to configure port priority, LACP link protection uses the default value for port priority (127).

## Enabling LACP Link Protection

To enable LACP link protection for aggregated Ethernet interfaces on the chassis, use the **link-protection** statement at the **[edit chassis aggregated-devices ethernet lacp]** hierarchy level:

```
[edit chassis aggregated-devices ethernet lacp]
link-protection {
  non-revertive;
}
```

By default, LACP link protection reverts to a higher-priority (lower-numbered) link when that higher-priority link becomes operational or a link is added to the aggregator that is determined to be higher in priority. However, you can suppress link calculation by adding the **non-revertive** statement to the LACP link protection configuration. In nonrevertive mode, after a link is active and collecting and distributing packets, the subsequent addition of a higher-priority (better) link does not result in a switch, and the current link remains active.



**CAUTION:** If both ends of an aggregator have LACP link protection enabled, make sure to configure both ends of the aggregator to use the same mode. Mismatching LACP link protection modes can result in lost traffic.

## Configuring System Priority

To configure LACP system priority for aggregated Ethernet interfaces on the chassis, use the **system-priority** statement at the **[edit chassis aggregated-devices ethernet lacp]** hierarchy level:

```
[edit chassis aggregated-devices ethernet lacp]
system-priority priority;
```

The system priority is a 2-octet binary value that is part of the LACP system ID. The LACP system ID consists of the system priority as the two most-significant octets and the interface MAC address as the six least-significant octets. The system with the numerically lower value for system priority has the higher priority. By default, system priority is 127, with a range of 0 through 65,535.

## Configuring the Maximum Links Limit

To configure the maximum links limit, use the **maximum-links** statement at the **[edit chassis aggregated-devices]** hierarchy level:

```
[edit chassis aggregated-devices]
maximum-links maximum-links-limit;
```

## Configuring PPM on Junos Fusion

If you use Junos Fusion with Junos OS Release 14.2R3, you need to ensure that link aggregation (and STP) work properly by configuring timers for the periodic packet management (PPM) daemons on the aggregation and satellite devices. We recommend using the following timer values:

```
[edit routing-options ppm]
redistribution-timer 120;
tcp-keepalive-interval 3000;
tcp-keepalive-idle 3000;
```

These values are configured by default if you use Junos Fusion with Junos OS Release 14.2R4 or later.

### Related Documentation

- [Configuring an Aggregated Ethernet Interface on page 126](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

- [Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 128](#)
- [Configuring Aggregated SONET/SDH Interfaces](#)

## Configuring the Number of Aggregated Ethernet Interfaces on the Device

By default, no aggregated Ethernet interfaces are created. You must set the number of aggregated Ethernet interfaces on the routing device before you can configure them.

For M Series and T Series routers you can configure a maximum of 128 aggregated interfaces (LAG bundles). On MX Series routers running Junos release 14.2R2 and earlier, you can configure a maximum of 480 aggregated interfaces. For MX Series routers running Junos release 14.2R3 and later you can configure a maximum of 1000 aggregated interfaces. For MX2010 and MX2020 routers you can configure a maximum of 800 aggregated interfaces. In all cases the aggregated interfaces are numbered from **ae0** through **ae4092**.



**NOTE:** On a Junos Fusion Fabric, you can include extended ports (physical interface on a satellite device that provides a connection to servers or endpoints) or local ports in link aggregation groups (LAGs) and MC-LAGs, but not both. For information on extended ports, see *Understanding Junos Fusion Ports*.

For SONET/SDH, starting with Junos OS Release 13.2, the maximum number of logical interfaces is 16, numbered from **as0** through **as15**.

1. Specify that you want to access the aggregated Ethernet configuration on the device.

```
user@host# edit chassis aggregated-devices ethernet
```

2. Set the number of aggregated Ethernet interfaces.

```
[edit chassis aggregated-devices ethernet]
user@host# set device-count number
```

You must also specify the constituent physical links by including the **802.3ad** statement at the **[edit interfaces *interface-name* fastether-options]** or **[edit interfaces *interface-name* gigether-options]** hierarchy level.

### Related Documentation

- For information about physical links, see [Configuring an Aggregated Ethernet Interface on page 126](#)
- For a sample configuration, see [Example: Configuring Aggregated Ethernet Interfaces on page 139](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*
- For information about configuring aggregated devices, see the *Junos OS Administration Library for Routing Devices*.

## Configuring Aggregated Ethernet Link Speed

On aggregated Ethernet interfaces, you can set the required link speed for all interfaces included in the bundle. Generally, all interfaces that make up a bundle must have the same speed. If you include in the aggregated Ethernet interface an individual link that has a speed different from the speed that you specify in the **link-speed** parameter, an error message is logged. However, starting with Junos OS Release 13.2, aggregated Ethernet supports the following mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers:

- Member links of different modes (WAN and LAN) for 10-Gigabit Ethernet links.
- Member links of different rates: 10-Gigabit Ethernet, 40-Gigabit Ethernet, 50-Gigabit Ethernet, 100-Gigabit Ethernet, and OC192 (10-Gigabit Ethernet WAN mode)

Starting with Junos OS Release 14.2, aggregated Ethernet supports mixed link speeds on PTX Series Packet Transport Routers.



### NOTE:

- Member links of 50-Gigabit Ethernet can only be configured using the 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP (PD-1CE-CFP-FPC4).
- Starting with Junos OS Release 13.2, 100-Gigabit Ethernet member links can be configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP. This 100-Gigabit Ethernet member link can be included in an aggregated Ethernet link that includes member links of other interfaces as well. In releases before Junos OS Release 13.2, the 100-Gigabit Ethernet member link configured using the two 50-Gigabit Ethernet interfaces of 100-Gigabit Ethernet PIC with CFP cannot be included in an aggregated Ethernet link that includes member links of other interfaces.

To configure member links of mixed rates and mixed modes on T640, T1600, T4000, TX Matrix Plus, and PTX routers, you need to configure the **mixed** option for the **[edit interfaces aex aggregated-ether-options link-speed]** statement.

To set the required link speed:

1. Specify that you want to configure the aggregated Ethernet options.

```
user@host# edit interfaces interface-name aggregated-ether-options
```

2. Configure the link speed.

```
[edit interfaces interface-name aggregated-ether-options ]
user@host# set link-speed speed
```

**speed** can be in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Aggregated Ethernet interfaces on the M120 router can have one of the following speeds:

- **100m**—Links are 100 Mbps.
- **10g**—Links are 10 Gbps.
- **1g**—Links are 1 Gbps.
- **oc192**—Links are OC192 or STM64c.

Aggregated Ethernet links on EX Series switches can be configured to operate at one of the following speeds:

- **10m**—Links are 10 Mbps.
- **100m**—Links are 100 Mbps.
- **1g**—Links are 1 Gbps.
- **10g**—Links are 10 Gbps.
- **50g**—Links are 50 Gbps.

Aggregated Ethernet links on T Series routers can be configured to operate at one of the following speeds:

- **100g**—Links are 100 Gbps.
- **100m**—Links are 100 Mbps.
- **10g**—Links are 10 Gbps.
- **1g**—Links are 1 Gbps.
- **40g**—Links are 40 Gbps.
- **50g**—Links are 50 Gbps.
- **80g**—Links are 80 Gbps.
- **8g**—Links are 8 Gbps.
- **mixed**—Links are of various speeds.
- **oc192**—Links are OC192.

**Related  
Documentation**

- [aggregated-ether-options on page 872](#)
- [Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Aggregated Ethernet Minimum Links

On aggregated Ethernet interfaces, you can configure the minimum number of links that must be up for the bundle as a whole to be labeled **up**. By default, only one link must be up for the bundle to be labeled **up**.

To configure the minimum number of links:

1. Specify that you want to configure the aggregated Ethernet options.

```
user@host# edit interfaces interface-name aggregated-ether-options
```

2. Configure the minimum number of links.

```
[edit interfaces interface-name aggregated-ether-options]  
user@host# set minimum-links number
```

On M120, M320, MX Series, T Series, and TX Matrix routers with Ethernet interfaces, and EX 9200 switches, the valid range for **minimum-links *number*** is 1 through 16. When the maximum value (16) is specified, all configured links of a bundle must be up for the bundle to be labeled **up**.

On all other routers and on EX Series switches, other than EX8200 switches, the range of valid values for **minimum-links *number*** is 1 through 8. When the maximum value (8) is specified, all configured links of a bundle must be up for the bundle to be labeled **up**.

On EX8200 switches, the range of valid values for **minimum-links *number*** is 1 through 12. When the maximum value (12) is specified, all configured links of a bundle must be up for the bundle to be labeled **up**.

On MX Series routers, when Link Aggregation Control Protocol (LACP) is enabled on a link aggregation group (LAG) interface along with minimum links configuration, the bundle is considered to be up when the following two conditions are met:

- The specified minimum number of links are up.
- The links are in *collecting distributing* state—that is, collecting and distributing states are merged together to form a combined state (coupled control) for the aggregated port. Because independent control is not possible, the coupled control state machine does not wait for the partner to signal that collection has started before enabling both collection and distribution.

If the number of links configured in an aggregated Ethernet interface is less than the minimum link value configured under the **aggregated-ether-options** statement, the configuration commit fails and an error message is displayed.

- Related Documentation**
- [aggregated-ether-options on page 872](#)
  - [minimum-links on page 1065](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Tagged Aggregated Ethernet Interfaces

To specify aggregated Ethernet interfaces, include the **vlan-tagging** statement at the **[edit interfaces *aex*]** hierarchy level:

```
[edit interfaces aex]  
vlan-tagging;
```

You must also include the **vlan-id** statement:

`vlan-id number;`

You can include this statement at the following hierarchy levels:

- `[edit interfaces interface-name unit logical-unit-number]`
- `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]`

For more information about the `vlan-tagging` and `vlan-id` statements, see “[802.1Q VLANs Overview](#)” on page 236.

**Related  
Documentation**

- [vlan-id on page 1237](#)
- [vlan-tagging on page 1246](#)

## Configuring Untagged Aggregated Ethernet Interfaces

Packet tagging provides a logical way to differentiate traffic on ports which support multiple virtual local area network (VLAN). While you must configure aggregated Ethernet interfaces to receive tagged traffic, you must also configure aggregated Ethernet interfaces that can receive untagged traffic.

To configure an aggregated Ethernet interface as untagged, remove the `vlan-tagging` statement at the `[edit interfaces aex]` hierarchy level and remove the `vlan-id` statement from the following hierarchy levels:

- `[edit interfaces interface-name unit logical-unit-number]`
- `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]`



**NOTE:** You can configure only one logical interface (unit 0) on the port. The logical unit 0 is used to send and receive LACP or marker protocol data units (PDUs) to and from the individual links.

[Table 14 on page 147](#) lists untagged aggregated Ethernet and LACP support by PIC and router.

**Table 14: Untagged Aggregated Ethernet and LACP Support by PIC and Platform**

PIC Type	M Series	LACP	T Series	LACP
4-port Fast Ethernet PIC Type 1	Yes	Yes	Yes	Yes
1-port Gigabit Ethernet PIC Type 1	Yes	Yes	Yes	Yes
2-port Gigabit Ethernet PIC Type 2	Yes	Yes	Yes	Yes
4-port Gigabit Ethernet PIC Type 2	Yes	Yes	Yes	Yes

Table 14: Untagged Aggregated Ethernet and LACP Support by PIC and Platform (*continued*)

PIC Type	M Series	LACP	T Series	LACP
1-port 10-Gigabit Ethernet M160	Yes	Yes	NA	NA
10-port Gigabit Ethernet PIC Type 3	Yes (M120, M320)	Yes	Yes	Yes
1-port 10-Gigabit Ethernet PIC Type 3	N/A	NA	Yes	Yes
8-port Gigabit Ethernet PIC Type 3	Yes	Yes	Yes	Yes

The 8-port Fast Ethernet PIC does not support untagged aggregated Ethernet or LACP.

Syslog messages are logged if you try to configure an untagged aggregated Ethernet interface using an unsupported PIC type.

#### Related Documentation

- [Configuring Tagged Aggregated Ethernet Interfaces on page 146](#)
- [Configuring LACP for Aggregated Ethernet Interfaces on page 148.](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring LACP for Aggregated Ethernet Interfaces

For aggregated Ethernet interfaces, you can configure the Link Aggregation Control Protocol (LACP). LACP is one method of bundling several physical interfaces to form one logical interface. You can configure both VLAN-tagged and untagged aggregated Ethernet with or without LACP enabled.



**NOTE:** Starting with Junos OS Release 14.1, you can configure aggregated Ethernet interfaces with LACP on logical systems within an MX Series router.

For Multichassis Link Aggregation (MC-LAG), you must specify the **system-id** and **admin key**. MC-LAG peers use the same **system-id** while sending the LACP messages. The **system-id** can be configured on the MC-LAG network device and synchronized between peers for validation.

LACP exchanges are made between actors and partners. An actor is the local interface in an LACP exchange. A partner is the remote interface in an LACP exchange.

LACP is defined in IEEE 802.3ad, *Aggregation of Multiple Link Segments*.

LACP was designed to achieve the following:

- Automatic addition and deletion of individual links to the aggregate bundle without user intervention



- Link monitoring to check whether both ends of the bundle are connected to the correct group

The Junos OS implementation of LACP provides link monitoring but not automatic addition and deletion of links.

The LACP mode can be active or passive. If the actor and partner are both in passive mode, they do not exchange LACP packets, which results in the aggregated Ethernet links not coming up. If either the actor or partner is active, they do exchange LACP packets. By default, LACP is turned off on aggregated Ethernet interfaces. If LACP is configured, it is in passive mode by default. To initiate transmission of LACP packets and response to LACP packets, you must configure LACP in active mode.



**NOTE:** LACP can link together multiple different physical interfaces, but only features that are supported across all of the linked devices will be supported in the resulting link aggregation group (LAG) bundle. For example, different PICs can support a different number of forwarding classes. If you use link aggregation to link together the ports of a PIC that supports up to 16 forwarding classes with a PIC that supports up to 8 forwarding classes, the resulting LAG bundle will only support up to 8 forwarding classes. Similarly, linking together a PIC that supports WRED with a PIC that does not support it will result in a LAG bundle that does not support WRED.

To enable LACP active mode, include the **lACP** statement at the **[edit interfaces interface-name aggregated-ether-options]** hierarchy level, and specify the **active** option:

```
[edit interfaces interface-name aggregated-ether-options]
lACP {
  active;
}
```



**NOTE:** The LACP process exists in the system only if you configure the system in either active or passive LACP mode.

If you restart the Link Aggregation Control Protocol (LACP) process consecutively without adequate sleep or pause time between the successive restarts, the LACP links might flap. To avoid this problem, you must restart the LACP process only after the refresh time of the periodic packet management (PPM) process is completed.

To restore the default behavior, include the **lACP** statement at the **[edit interfaces interface-name aggregated-ether-options]** hierarchy level, and specify the **passive** option:

```
[edit interfaces interface-name aggregated-ether-options]
lACP {
  passive;
}
```

Starting with Junos OS Release 12.2, you can also configure LACP to override the IEEE 802.3ad standard and to allow the standby link always to receive traffic. Overriding the default behavior facilitates subsecond failover.

To override the IEEE 802.3ad standard and facilitate subsecond failover, include the **fast-failover** statement at the **[edit interfaces *interface-name* aggregated-ether-options lacp]** hierarchy level.

When you configure the **accept-data** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level, the router processes packets received on a member link irrespective of the LACP state if the aggregated Ethernet bundle is up.



**NOTE:** When you use the **accept-data** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level, this behavior occurs:

- By default, the **accept-data** statement is not configured when LACP is enabled.
- You can configure the **accept-data** statement to improve convergence and reduce the number of dropped packets when member links in the bundle are enabled or disabled.
- When LACP is down and a member link receives packets, the router does not process packets as defined in the IEEE 802.1ax standard. According to this standard, the packets should be dropped, but they are processed instead because the **accept-data** statement is configured.

For more information, see the following sections:

- [Configuring the LACP Interval on page 150](#)
- [Configuring LACP Link Protection on page 151](#)
- [Configuring LACP Hold-Up Timer to Prevent Link Flapping on LAG Interfaces on page 154](#)
- [Tracing LACP Operations on page 155](#)
- [Sample Configuration for Configuring Aggregated Ethernet LACP on Tagged and Untagged Interfaces on page 155](#)

## Configuring the LACP Interval

By default, the actor and partner send LACP packets every second. You can configure the interval at which the interfaces send LACP packets by including the **periodic** statement at the **[edit interfaces *interface-name* aggregated-ether-options lacp]** hierarchy level:

```
[edit interfaces interface-name aggregated-ether-options lacp]  
periodic interval;
```

The interval can be fast (every second) or slow (every 30 seconds). You can configure different periodic rates on active and passive interfaces. When you configure the active and passive interfaces at different rates, the transmitter honors the receiver's rate.



**NOTE:** Source address filtering does not work when LACP is enabled. This behavior is not applicable to T Series routers and PTX Series Packet Transport Routers. For more information about source address filtering, see [“Configuring MAC Address Filtering for Ethernet Interfaces” on page 13](#).

Percentage policers are not supported on aggregated Ethernet interfaces with the CCC protocol family configured. For more information about percentage policers, see the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide for Routing Devices*.

Generally, LACP is supported on all untagged aggregated Ethernet interfaces. For more information, see [“Configuring Untagged Aggregated Ethernet Interfaces” on page 147](#).

For M Series Multiservice Edge Routers with enhanced Flexible PIC Concentrators (FPCs) and T Series routers, LACP over VLAN-tagged aggregated Ethernet interfaces is supported. For 8-port, 12-port, and 48-port Fast Ethernet PICs, LACP over VLAN-tagged interfaces is not supported.

LACP Fast Periodic, which is achieved by configuring fast (every second) intervals for periodic transmission of LACP packets, is supported with graceful Routing Engine switchover (GRES) on MX Series routers only.

## Configuring LACP Link Protection

To force active and standby links within an aggregated Ethernet, you can configure LACP link protection and system priority at the aggregated Ethernet interface level using the **link-protection** and **system-priority** statements. Configuring values at this level results in only the configured interfaces using the defined configuration. LACP interface configuration also enables you to override global (chassis) LACP settings.

LACP link protection also uses port priority. You can configure port priority at the Ethernet interface **[gigether-options]** hierarchy level using the **port-priority** statement. If you choose not to configure port priority, LACP link protection uses the default value for port priority (127).



**NOTE:**

- When using LACP link protection, you can configure only two member links to an aggregated Ethernet interface: one active and one standby.
- LACP link protection supports per-unit scheduling configuration on aggregated Ethernet interfaces.

- [Enabling LACP Link Protection on page 152](#)
- [Configuring LACP System Priority on page 153](#)
- [Configuring LACP System Identifier on page 153](#)

- [Configuring LACP administrative Key on page 153](#)
- [Configuring LACP Port Priority on page 154](#)

### Enabling LACP Link Protection

To enable LACP link protection for an aggregated Ethernet interface, use the **link-protection** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level:

```
[edit interfaces aeX aggregated-ether-options lacp]
link-protection;
  disable;
  revertive;
  non-revertive;
}
```

By default, LACP link protection reverts to a higher-priority (lower-numbered) link when that higher-priority link becomes operational or a link is added to the aggregator that is determined to be higher in priority. However, you can suppress link calculation by adding the **non-revertive** statement to the LACP link protection configuration. In nonrevertive mode, once a link is active and collecting and distributing packets, the subsequent addition of a higher-priority (better) link does not result in a switch and the current link remains active.

If LACP link protection is configured to be nonrevertive at the global (**[edit chassis]** hierarchy) level, you can add the **revertive** statement to the LACP link protection configuration to override the nonrevertive setting for the interface. In revertive mode, the addition of a higher-priority link to the aggregator results in LACP performing a priority recalculation and switching from the current active link to the new active link.



**CAUTION:** If both ends of an aggregator have LACP link protection enabled, make sure to configure both ends of the aggregator to use the same mode. Mismatching LACP link protection modes can result in lost traffic.

We strongly recommend that you use LACP on both ends of the aggregator, when you connect an aggregated Ethernet interface with two member interfaces of MX Series routers to any other vendor device. Otherwise, the vendor device (say a Layer 2 switch, or a router) will not be able to manage the traffic coming from the two link aggregated Ethernet bundle. As a result, you might observe the vendor device sending back the traffic to the backup member link of the aggregated Ethernet interface.

Currently, MX-MPC2-3D, MX-MPC2-3D-Q, MX-MPC2-3D-EQ, MX-MPC1-3D, MX-MPC1-3D-Q, and MPC-3D-16XGE-SFPP do not drop traffic coming back to the backup link, whereas DPCE-R-Q-20GE-2XGE, DPCE-R-Q-20GE-SFP, DPCE-R-Q-40GE-SFP, DPCE-R-Q-4XGE-XFP, DPCE-X-Q-40GE-SFP, and DPCE-X-Q-4XGE-XFP drop traffic coming to the backup link.

### Configuring LACP System Priority

---

To configure LACP system priority for aggregated Ethernet interfaces on the interface, use the **system-priority** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level:

```
[edit interfaces aeX aggregated-ether-options lacp]
system-priority;
```

The system priority is a 2-octet binary value that is part of the LACP system ID. The LACP system ID consists of the system priority as the two most-significant octets and the interface MAC address as the six least-significant octets. The system with the numerically lower value for system priority has the higher priority. By default, system priority is 127, with a range of 0 to 65,535.

### Configuring LACP System Identifier

---

To configure the LACP system identifier for aggregated Ethernet interfaces, use the **system-id** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level:

```
[edit interfaces aeX aggregated-ether-options lacp]
system-id system-id;
```

You must not configure the LACP system identifier by using the **system-id system-id** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level to be all zeros (00:00:00:00:00:00). If you attempt to commit a configuration with the system identifier to be all zeros, an error occurs during the commit operation.

The user-defined system identifier in LACP enables two ports from two separate routers (M Series or MX Series routers) to act as though they were part of the same aggregate group.

The system identifier is a 48-bit (6-byte) globally unique field. It is used in combination with a 16-bit system-priority value, which results in a unique LACP system identifier.

### Configuring LACP administrative Key

---

To configure an administrative key for LACP, include the **admin-key number** statement at the **[edit interfaces aeX aggregated-ether-options lacp]** hierarchy level:

```
[edit interfaces ae x aggregated-ether-options-lacp]
admin-key number;
```



**NOTE:** You must configure MC-LAG to configure the **admin-key** statement. For more information about MC-LAG, see *Configuring Multichassis Link Aggregation on MX Series Routers*.

---

### Configuring LACP Port Priority

---

To configure LACP port priority for aggregated Ethernet interfaces, use the **port-priority** statement at the **[edit interfaces *interface-name* gigether-options 802.3ad aeX lacp]** or **[edit interfaces *interface-name* fastether-options 802.3ad aeX lacp]** hierarchy levels:

```
[edit interfaces interface-name gigether-options 802.3ad aeX lacp]
port-priority priority;
```

The port priority is a 2-octet field that is part of the LACP port ID. The LACP port ID consists of the port priority as the two most-significant octets and the port number as the two least-significant octets. The system with the numerically lower value for port priority has the higher priority. By default, port priority is 127, with a range of 0 to 65,535.

Port aggregation selection is made by each system based on the highest port priority and is assigned by the system with the highest priority. Ports are selected and assigned starting with the highest priority port of the highest priority system and working down in priority from there.



**NOTE:** Port aggregation selection (discussed previously) is performed for the active link when LACP link protection is enabled. Without LACP link protection, port priority is not used in port aggregation selection.

---

### Configuring LACP Hold-Up Timer to Prevent Link Flapping on LAG Interfaces

On link aggregation group (LAG) interfaces, when a member (child) link goes down, its state changes from current to expired. This link might flap from the current state to the expired state and back to current state when it receives intermittent LACP protocol data units (PDUs) and keepalive timeouts. Such flapping can adversely affect the traffic on the link.

To prevent excessive flapping of a LAG child link, you can configure a hold-up timer on the LAG interface that is applicable to all member links on that particular interface. To hold up, in networking terms, means to prevent the transitioning of an interface from down to up for a specified time interval.

When configured, the hold-up timer is triggered when an LACP state machine tries to move to the current state from the expired or default state when it receives an LACP PDU. The hold-up timer is triggered only if the LACP state machine had acquired the current state at least once earlier. The timer is not triggered if LACP attempts to transition to the current state for the first time. LACP monitors the PDUs received on the child link but prevents the link from transitioning to current state. If no flapping is observed when the link receives the PDUs, the hold-up timer expires and triggers the member link to transition back to the current state. This transition is triggered as soon as the hold-up timer expires and not necessarily when the link receives a PDU.

To configure LACP hold-up timer for LAG interface, use the **hold-time up** statement at the **[edit interfaces *aex* aggregated-ether-options lacp]** hierarchy level.

**NOTE:**

- The hold-up timer keeps running even when the interface that receives the LACP PDU moves to the port disable state. The timer is then restarted if, before the timer expires, the interface comes up again and receives an LACP PDU from its neighbor. This ensures that the timer is maintained even during a quick physical port flap.
- When the following events occur, a hold-up timer is not triggered until the member link acquires the current state after the event:
  - LACP daemon restart
  - Deactivation and reactivation of child or aggregated Ethernet interface
  - Deletion and reconfiguration of child or aggregated Ethernet interface
  - System reboot
  - Routing Engine switchover

## Tracing LACP Operations

To trace the operations of the LACP process, include the **traceoptions** statement at the **[edit protocols lacp]** hierarchy level:

```
[edit protocols lacp]
traceoptions {
  file <filename> <files number> <size size> <world-readable | no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

## Sample Configuration for Configuring Aggregated Ethernet LACP on Tagged and Untagged Interfaces

Following configurations are examples of configuring aggregated Ethernet LACP on VLAN-tagged and untagged interfaces:

### LACP with VLAN-Tagged Aggregated Ethernet

```
[edit interfaces]
fe-5/0/1 {
  fastether-options {
    802.3ad ae0;
  }
}
ae0 {
  aggregated-ether-options {
    lacp {
      active;
    }
  }
  vlan-tagging;
  unit 0 {
    vlan-id 100;
    family inet {
```

**LACP with Untagged Aggregated Ethernet**

```
        address 10.1.1.2/24 {
            vrrp-group 0 {
                virtual-address 10.1.1.4;
                priority 200;
            }
        }
    }
}

[edit interfaces]
fe-5/0/1 {
    fastether-options {
        802.3ad ae0;
    }
}
ae0 {
    aggregated-ether-options {
        lacp {
            active;
        }
    }
    unit 0 {
        family inet {
            address 10.1.1.2/24 {
                vrrp-group 0 {
                    virtual-address 10.1.1.4;
                    priority 200;
                }
            }
        }
    }
}
```

**Related Documentation**

- *Junos OS Administration Library for Routing Devices*
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Aggregated Ethernet Link Protection

You can configure link protection for aggregated Ethernet interfaces to provide QoS on the links during operation.

On aggregated Ethernet interfaces, you designate a primary and backup link to support link protection. Egress traffic passes only through the designated primary link. This includes transit traffic and locally generated traffic on the router or switch. When the primary link fails, traffic is routed through the backup link. Because some traffic loss is unavoidable, egress traffic is not automatically routed back to the primary link when the primary link is reestablished. Instead, you manually control when traffic should be diverted back to the primary link from the designated backup link.





**NOTE:** Link protection is not supported on MX80.

- [Configuring Link Protection for Aggregated Ethernet Interfaces on page 157](#)
- [Configuring Primary and Backup Links for Link Aggregated Ethernet Interfaces on page 157](#)
- [Reverting Traffic to a Primary Link When Traffic is Passing Through a Backup Link on page 157](#)
- [Disabling Link Protection for Aggregated Ethernet Interfaces on page 158](#)

## Configuring Link Protection for Aggregated Ethernet Interfaces

Aggregated Ethernet interfaces support link protection to ensure QoS on the interface.

To configure link protection:

1. Specify that you want to configure the options for an aggregated Ethernet interface.

```
user@host# edit interfaces aex aggregated-ether-options
```

2. Configure the link protection mode.

```
[edit interfaces aex aggregated-ether-options]
user@host# set link-protection
```

## Configuring Primary and Backup Links for Link Aggregated Ethernet Interfaces

To configure link protection, you must specify a primary and a secondary, or backup, link.

To configure a primary link and a backup link:

1. Configure the primary logical interface.

```
[edit interfaces interface-name]
user@host# set (fastether-options | gige-ether-options) 802.3ad aex primary
```

2. Configure the backup logical interface.

```
[edit interfaces interface-name]
user@host# set (fastether-options | gige-ether-options) 802.3ad aex backup
```

## Reverting Traffic to a Primary Link When Traffic is Passing Through a Backup Link

On aggregated Ethernet interfaces, you designate a primary and backup link to support link protection. Egress traffic passes only through the designated primary link. This includes transit traffic and locally generated traffic on the router or switch. When the primary link fails, traffic is routed through the backup link. Because some traffic loss is unavoidable, egress traffic is not automatically routed back to the primary link when the primary link is reestablished. Instead, you manually control when traffic should be diverted back to the primary link from the designated backup link.

To manually control when traffic should be diverted back to the primary link from the designated backup link, enter the following operational command:

```
user@host> request interface revert aex
```

## Disabling Link Protection for Aggregated Ethernet Interfaces

To disable link protection, issue the **delete interface revert aex** configuration command.

```
user@host# delete interfaces aex aggregated-ether-options link-protection
```

## Example: Configuring Aggregated Ethernet Link Protection

---

The following configuration enables link protection on the **ae0** interface, and specifies the **ge-1/0/0** interface as the primary link and **ge-1/0/1** as the secondary link.

```
[edit interfaces]
ae0 {
  aggregated-ether-options {
    link protection;
  }
}
[edit interfaces]
ge-1/0/0 {
  gigether-options {
    802.3ad ae0 primary;
  }
}
[edit interfaces]
ge-1/0/1 {
  gigether-options {
    802.3ad ae0 backup;
  }
}
```

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Shared Scheduling on Aggregated Ethernet Interfaces

---

You can configure shared scheduling on aggregated Ethernet interfaces in link protection mode on Gigabit Ethernet Intelligent Queuing 2 (IQ2) and Ethernet Enhanced IQ2 (IQ2E) PICs on M320 routers.

To configure shared scheduling on aggregated Ethernet interfaces:

1. Specify that you want to configure the options for an aggregated Ethernet interface.

```
user@host# edit interfaces aex aggregated-ether-options
```

2. Configure the link protection mode.

```
[edit interfaces aex aggregated-ether-options]
user@host# set link-protection
```

3. Configure shared scheduling.

```
[edit interfaces aex aggregated-ether-options]
user@host# top
[edit]
```

```
user@host# edit interfaces aex shared-scheduler
```

**Related Documentation**

- [Configuring Aggregated Ethernet Link Protection on page 156](#)

## Configuring Scheduler on Aggregated Ethernet Interfaces Without Link Protection

On aggregated Ethernet interfaces, you can configure scheduler in non-link-protect mode on the following platforms:

- MX-Series
- M120 and M320 with IQ2 PIC
- T-series platforms (T620 and T320) with IQ2 PIC

The scheduler functions supported are:

- Per unit scheduler
- Hierarchical scheduler
- Shaping at the physical interface

To configure the hierarchical scheduler on aggregated Ethernet interfaces in the non link-protect mode, include the **hierarchical-scheduler** statement at the **[edit interfaces aeX]** hierarchy level:

```
[edit interfaces aeX hierarchical-scheduler]
```

Prior to Junos OS Release 9.6, the hierarchical scheduler mode on these models required the **aggregated-ether-options** statement **link-protection** option. If a **link-protection** option is not specified, the scheduler is configured in non-link-protect mode.

To specify the member link bandwidth derivation based on the equal division model (**scale**) or the replication model (**replicate**) on aggregated Ethernet interfaces, include the **member-link-scheduler (scale | replicate)** option at the **[edit class-of-service interfaces aeX]** hierarchy level. The default setting is **scale**.

```
[edit class-of-service interfaces aeX member-link-scheduler (scale | replicate)]
```



**NOTE:** In link-protect mode, only one link is active at a time and the other link acts as the backup link, whereas in a non link-protect mode, all the links of the aggregate bundle are active at the same time. There is no backup link. If a link goes down or a new link is added to the bundle, traffic redistribution occurs.

**Related Documentation**

- [Configuring Hierarchical CoS for a Subscriber Interface of Aggregated Ethernet Links](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- For more information on the hierarchical scheduler (CoS), see the *Class of Service Feature Guide for Routing Devices*.

## Configuring Symmetrical Load Balancing on an 802.3ad Link Aggregation Group on MX Series Routers

---

- [Symmetrical Load Balancing on an 802.3ad LAG on MX Series Routers Overview on page 160](#)
- [Configuring Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers on page 160](#)
- [Configuring Symmetrical Load Balancing on Trio-Based MPCs on page 163](#)
- [Example Configurations on page 165](#)

### Symmetrical Load Balancing on an 802.3ad LAG on MX Series Routers Overview

MX Series routers with Aggregated Ethernet PICs support symmetrical load balancing on an 802.3ad LAG. This feature is significant when two MX Series routers are connected transparently through deep packet inspection (DPI) devices over an LAG bundle. DPI devices keep track of flows and require information of a given flow in both forward and reverse directions. Without symmetrical load balancing on an 802.3ad LAG, the DPIs could misunderstand the flow, leading to traffic disruptions. By using this feature, a given flow of traffic (duplex) is ensured for the same devices in both directions.

Symmetrical load balancing on an 802.3ad LAG utilizes a mechanism of interchanging the source and destination addresses for a hash computation of fields, such as source address and destination address. The result of a hash computed on these fields is used to choose the link of the LAG. The hash-computation for the forward and reverse flow must be identical. This is achieved by swapping source fields with destination fields for the reverse flow. The swapped operation is referred to as *complement hash computation* or **symmetric-hash complement** and the regular (or unswapped) operation as *symmetric-hash computation* or **symmetric-hash**. The swappable fields are MAC address, IP address, and port.

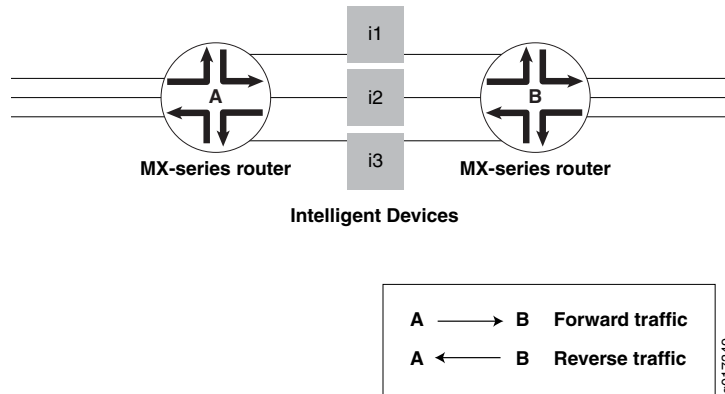
### Configuring Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers

You can specify whether symmetric hash or complement hash is done for load-balancing traffic. To configure symmetric hash, use the **symmetric-hash** statement at the **[edit forwarding-options hash-key family inet]** hierarchy level. To configure symmetric hash complement, use the **symmetric-hash complement** statement and option at the **[edit forwarding-options hash-key family inet]** hierarchy level.

These operations can also be performed at the PIC level by specifying a *hash key*. To configure a hash key at the PIC level, use the **symmetric-hash** or **symmetric-hash complement** statement at the **[edit chassis hash-key family inet]** and **[edit chassis hash-key family multiservice]** hierarchy levels.

Consider the example in [Figure 7 on page 161](#).

**Figure 7: Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers**



Router A is configured with symmetric hash and Router B is configured with symmetric hash complement. Thus, for a given flow  $fx$ , post hash computation is from Router A to Router B through i2. The reverse traffic for the same flow  $fx$  is from Router B to Router A through the same i2 device as its hashing (done after swapping source and destination fields) and returns the same link index; since it is performed on the interchanged source and destination addresses.

However, the link chosen may or may not correspond to what was attached to the DPI. In other words, the hashing result should point to the same links that are connected, so that the traffic flows through the same DPI devices in both directions. To make sure this happens, you need to also configure the counterpart ports (ports that are connected to same DPI-IN) with the identical link index. This is done when configuring a child-link into the LAG bundle. This ensures that the link chosen for a given hash result is always the same on either router.

Note that any two links connected to each other should have the same link index and these link indices must be unique in a given bundle.

**NOTE:**

The following restrictions apply when configuring symmetric load balancing on an 802.3ad LAG on MX Series routers:

- The Packet Forwarding Engine (PFE) can be configured to hash the traffic in either symmetric or complement mode. A single PFE complex cannot work simultaneously in both operational modes and such a configuration can yield undesirable results.
- The per-PFE setting overrides the chassis-wide setting only for the family configured. For the other families, the PFE complex still inherits the chassis-wide setting (when configured) or the default setting.
- This feature supports VPLS, INET, and bridged traffic only.
- This feature cannot work in tandem with the per-flow-hash-seed load-balancing option. It requires that all the PFE complexes configured in complementary fashion share the same seed. A change in the seed between two counterpart PFE complexes may yield undesired results.

For additional information, see the *Junos OS VPNs Library for Routing Devices* and the *Junos OS Administration Library for Routing Devices*.

**Example Configuration  
Statements**

To configure 802.3ad LAG parameters at the bundle level:

```
[edit interfaces]
g(x)e-fpc/pic/port {
  gigether-options {
    802.3ad {
      bundle;
      link-index number;
    }
  }
}
```

where the **link-index number** ranges from 0 through 15.

You can check the link index configured above using the **show interfaces** command:

```
[edit forwarding-options hash-key]
family inet {
  layer-3;
  layer-4;
  symmetric-hash {
    [complement;]
  }
}
family multiservice {
  source-mac;
  destination-mac;
  payload {
    ip {
      layer-3 {
        source-ip-only | destination-ip-only;
```

```

    }
    layer-4;
  }
}
symmetric-hash {
  [complement;]
}
}

```

For load-balancing Layer 2 traffic based on Layer 3 fields, you can configure 802.3ad LAG parameters at a per PIC level. These configuration options are available under the chassis hierarchy as follows:

```

[edit chassis]
fpc X {
  pic Y {
    .
    .
    .
    hash-key {
      family inet {
        layer-3;
        layer-4;
        symmetric-hash {
          [complement;]
        }
      }
    }
    family multiservice {
      source-mac;
      destination-mac;
      payload {
        ip {
          layer-3 {
            source-ip-only | destination-ip-only;
          }
          layer-4;
        }
      }
      symmetric-hash {
        [complement;]
      }
    }
  }
}
.
.
.
}
}

```

## Configuring Symmetrical Load Balancing on Trio-Based MPCs

With some configuration differences, symmetrical load-balancing over an 802.3ad link aggregation group is supported on MX Series routers with Trio-based MPCs.

To achieve symmetrical load-balancing on Trio-Based MPCs, the following needs to be done:

- Compute a Symmetrical Hash

Both routers must compute the same hash value from the flow in the forward and reverse directions. On Trio-based platforms, the calculated hash value is independent of the direction of the flow, and hence is always symmetric in nature. For this reason, no specific configuration is needed to compute a symmetric hash value on Trio-based platforms.

However, it should be noted that the fields used to configure the hash should have identical include and exclude settings on both ends of the LAG.

- Configure Link Indexes

To allow both routers to choose the same link using the same hash value, the links within the LAG must be configured with the same link index on both routers. This can be achieved with the **link-index** statement.

- Enable Symmetric Load Balancing

To configure symmetric load balancing on Trio-based MPCs, include the **symmetric** statement at the **[edit forwarding-options enhanced-hash-key]** hierarchy level. This statement is applicable to Trio-based platforms only.

The **symmetric** statement can be used with any protocol family and enables symmetric load-balancing for all aggregated Ethernet bundles on the router. The statement needs to be enabled at both ends of the LAG. This statement is disabled by default.

- Achieve Symmetry for Bridged and Routed Traffic

In some deployments, the LAG bundle on which symmetry is desired is traversed by Layer 2 bridged traffic in the upstream direction and by IPv4 routed traffic in the downstream direction. In such cases, the computed hash is different in each direction because the Ethernet MAC addresses are taken into account for bridged packets. To overcome this, you can exclude source and destination MAC addresses from the enhanced-hash-key computation.

To exclude source and destination MAC addresses from the enhanced-hash-key computation, include the **no-mac-addresses** statement at the **[edit forwarding-options enhanced-hash-key family multiservice]** hierarchy level. This statement is disabled by default.

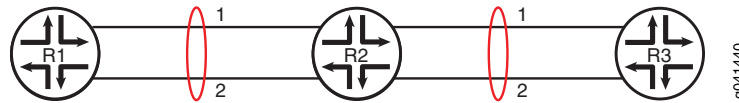
When symmetrical load balancing is enabled on Trio-based MPCs, keep in mind the following caveats:

- Traffic polarization is a phenomenon that occurs when using topologies that distribute traffic by using hashing of the same type. When routers are cascaded, traffic polarization can occur, and this can lead to unequal traffic distribution.

Traffic polarization occurs when LAGs are configured on cascaded routers. For example, in [Figure 8 on page 165](#), if a certain flow uses Link 1 of the aggregated Ethernet bundle between Device R1 and Device R2, the flow also uses Link 1 of the aggregated Ethernet bundle between Device R2 and Device R3.



**Figure 8: Traffic Polarization on Cascaded Routers When Symmetrical Load Balancing is Enabled on Trio-based MPCs**



This is unlike having a random link selection algorithm, where a flow might use Link 1 of the aggregated Ethernet bundle between Device R1 and Device R2, and Link 2 of the aggregated Ethernet bundle between Device R2 and Device R3.

- Symmetric load balancing is not applicable to per-prefix load-balancing where the hash is computed based on the route prefix.
- Symmetric load balancing is not applicable to MPLS or VPLS traffic, because in these scenarios the labels are not the same in both directions.

## Example Configurations

- [Example Configurations of Chassis Wide Settings on page 165](#)
- [Example Configurations of Per-Packet-Forwarding-Engine Settings on page 165](#)

### Example Configurations of Chassis Wide Settings

```
Router A user@host> show configuration forwarding-options hash-key
family multiservice {
  payload {
    ip {
      layer-3;
    }
  }
  symmetric hash;
}
```

```
Router B user@host> show configuration forwarding-options hash-key
family multiservice {
  payload {
    ip {
      layer-3;
    }
  }
  symmetric-hash {
    complement;
  }
}
```

### Example Configurations of Per-Packet-Forwarding-Engine Settings

```
Router A user@host> show configuration chassis fpc 2 pic 2 hash-key
family multiservice {
  payload {
    ip {
      layer-3;
    }
  }
}
```

```
    symmetric hash;  
}
```

```
Router B user@host> show configuration chassis fpc 2 pic 3 hash-key  
family multiservice {  
  payload {  
    ip {  
      layer-3;  
    }  
  }  
  symmetric-hash {  
    complement;  
  }  
}
```

- Related Documentation**
- *Ethernet Interfaces Feature Guide for Routing Devices*
  - For additional information, see the *Junos OS VPNs Library for Routing Devices* and the *Junos OS Administration Library for Routing Devices*.

---

## Understanding Aggregated Ethernet Load Balancing

The link aggregation feature is used to bundle several physical aggregated Ethernet interfaces to form one logical interface. One or more links are aggregated to form a virtual link or link aggregation group (LAG). The MAC client treats this virtual link as if it were a single link. Link aggregation increases bandwidth, provides graceful degradation as failure occurs, and increases availability.

In addition to these benefits, an aggregated Ethernet bundle is enhanced to provide load-balancing capabilities that ensure that the link utilization among the member links of the aggregated Ethernet bundle are fully and efficiently utilized.

The load-balancing feature allows a device to divide incoming and outgoing traffic along multiple paths or interfaces in order to reduce congestion in the network. Load balancing improves the utilization of various network paths and provides more effective network bandwidth.

Typically, the applications that use load balancing include:

- Aggregated Interfaces (Layer 2)

Aggregated Interfaces (also called AE for aggregated Ethernet, and AS for aggregated SONET) are a Layer 2 mechanism for load-balancing across multiple interfaces between two devices. Because this is a Layer 2 load-balancing mechanism, all of the individual component links must be between the same two devices on each end. Junos OS supports a non-signaled (static) configuration for Ethernet and SONET, as well as the 802.3ad standardized LACP protocol for negotiation over Ethernet links.

- Equal-Cost Multipath (ECMP) (Layer 3)

By default, when there are multiple equal-cost paths to the same destination for the active route, Junos OS uses a hash algorithm to choose one of the next-hop addresses to install in the forwarding table. Whenever the set of next hops for a destination changes in any way, the next-hop address is rechosen using the hash algorithm. There is also an option that allows multiple next-hop addresses to be installed in the forwarding table, known as per-packet load balancing.

ECMP load balancing can be:

- Across BGP paths (BGP multipath)
- Within a BGP path, across multiple LSPs

In complex Ethernet topologies, traffic imbalances occur due to increased traffic flow, and load balancing becomes challenging for some of the following reasons:

- Incorrect load balancing by aggregate next hops
- Incorrect packet hash computation
- Insufficient variance in the packet flow
- Incorrect pattern selection

As a result of traffic imbalance, the load is not well distributed causing congestion in certain links, whereas some other links are not efficiently utilized.

To overcome these challenges, Junos OS provides the following solutions for resolving the genuine traffic imbalance on aggregated Ethernet bundles (IEEE 802.3ad).

- Adaptive Load Balancing

Adaptive load balancing uses a feedback mechanism to correct a genuine traffic imbalance. To correct the imbalance weights, the bandwidth and packet stream of links are adapted to achieve efficient traffic distribution across the links in an AE bundle.

To configure adaptive load balancing, include the **adaptive** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** Adaptive load balancing is not supported if the VLAN ID is configured on the aggregated Ethernet interface. This limitation affects the PTX Series Packet Transport Routers and QFX10000 switches only.

To configure the tolerance value as a percentage, include the **tolerance** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.

To configure adaptive load balancing based on packets per second (instead of the default bits per second setting), include the **pps** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.

To configure the scan interval for the hash value based on the sample rate for the last two seconds, include the **scan-interval** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.



**NOTE:** The **pps** and **scan-interval** optional keywords are supported on PTX Series Packet Transport Routers only.

- Per-Packet Random Spray Load Balancing

When the adaptive load-balancing option fails, per-packet random spray load balancing serves as a last resort. It ensures that the members of an AE bundle are equally loaded without taking bandwidth into consideration. Per packet causes packet reordering and hence is recommended only if the applications absorb reordering. Per-packet random spray eliminates traffic imbalance that occurs as a result of software errors, except for packet hash.

To configure per-packet random spray load balancing, include the **per-packet** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** The Per-Packet option for load balancing is not supported on PTX Series Packet Transport Routers.

The aggregated Ethernet load-balancing solutions are mutually exclusive. When more than one of the load-balancing solutions is configured, the solution that is configured last overrides the previously configured one. You can verify the load-balancing solution being used by issuing the **show interfaces aex aggregated-ether-options load-balance** command.

#### Related Documentation

- [Example: Configuring Aggregated Ethernet Load Balancing on page 171](#)

---

## Example: Configuring Aggregated Ethernet Load Balancing

- [Understanding Aggregated Ethernet Load Balancing on page 169](#)
- [Example: Configuring Aggregated Ethernet Load Balancing on page 171](#)

## Understanding Aggregated Ethernet Load Balancing

The link aggregation feature is used to bundle several physical aggregated Ethernet interfaces to form one logical interface. One or more links are aggregated to form a virtual link or link aggregation group (LAG). The MAC client treats this virtual link as if it were a single link. Link aggregation increases bandwidth, provides graceful degradation as failure occurs, and increases availability.

In addition to these benefits, an aggregated Ethernet bundle is enhanced to provide load-balancing capabilities that ensure that the link utilization among the member links of the aggregated Ethernet bundle are fully and efficiently utilized.

The load-balancing feature allows a device to divide incoming and outgoing traffic along multiple paths or interfaces in order to reduce congestion in the network. Load balancing improves the utilization of various network paths and provides more effective network bandwidth.

Typically, the applications that use load balancing include:

- Aggregated Interfaces (Layer 2)

Aggregated Interfaces (also called AE for aggregated Ethernet, and AS for aggregated SONET) are a Layer 2 mechanism for load-balancing across multiple interfaces between two devices. Because this is a Layer 2 load-balancing mechanism, all of the individual component links must be between the same two devices on each end. Junos OS supports a non-signaled (static) configuration for Ethernet and SONET, as well as the 802.3ad standardized LACP protocol for negotiation over Ethernet links.

- Equal-Cost Multipath (ECMP) (Layer 3)

By default, when there are multiple equal-cost paths to the same destination for the active route, Junos OS uses a hash algorithm to choose one of the next-hop addresses to install in the forwarding table. Whenever the set of next hops for a destination changes in any way, the next-hop address is rechosen using the hash algorithm. There is also an option that allows multiple next-hop addresses to be installed in the forwarding table, known as per-packet load balancing.

ECMP load balancing can be:

- Across BGP paths (BGP multipath)
- Within a BGP path, across multiple LSPs

In complex Ethernet topologies, traffic imbalances occur due to increased traffic flow, and load balancing becomes challenging for some of the following reasons:

- Incorrect load balancing by aggregate next hops
- Incorrect packet hash computation
- Insufficient variance in the packet flow
- Incorrect pattern selection

As a result of traffic imbalance, the load is not well distributed causing congestion in certain links, whereas some other links are not efficiently utilized.

To overcome these challenges, Junos OS provides the following solutions for resolving the genuine traffic imbalance on aggregated Ethernet bundles (IEEE 802.3ad).

- Adaptive Load Balancing

Adaptive load balancing uses a feedback mechanism to correct a genuine traffic imbalance. To correct the imbalance weights, the bandwidth and packet stream of links are adapted to achieve efficient traffic distribution across the links in an AE bundle.

To configure adaptive load balancing, include the **adaptive** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** Adaptive load balancing is not supported if the VLAN ID is configured on the aggregated Ethernet interface. This limitation affects the PTX Series Packet Transport Routers and QFX10000 switches only.

To configure the tolerance value as a percentage, include the **tolerance** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.

To configure adaptive load balancing based on packets per second (instead of the default bits per second setting), include the **pps** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.

To configure the scan interval for the hash value based on the sample rate for the last two seconds, include the **scan-interval** optional keyword at the **[edit interfaces aex aggregated-ether-options load-balance adaptive]** hierarchy level.



**NOTE:** The **pps** and **scan-interval** optional keywords are supported on PTX Series Packet Transport Routers only.

- Per-Packet Random Spray Load Balancing

When the adaptive load-balancing option fails, per-packet random spray load balancing serves as a last resort. It ensures that the members of an AE bundle are equally loaded without taking bandwidth into consideration. Per packet causes packet reordering and hence is recommended only if the applications absorb reordering. Per-packet random spray eliminates traffic imbalance that occurs as a result of software errors, except for packet hash.

To configure per-packet random spray load balancing, include the **per-packet** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** The Per-Packet option for load balancing is not supported on PTX Series Packet Transport Routers.

The aggregated Ethernet load-balancing solutions are mutually exclusive. When more than one of the load-balancing solutions is configured, the solution that is configured last overrides the previously configured one. You can verify the load-balancing solution being used by issuing the **show interfaces aex aggregated-ether-options load-balance** command.

## Example: Configuring Aggregated Ethernet Load Balancing

This example shows how to configure aggregated Ethernet load balancing.

- [Requirements on page 171](#)
- [Overview on page 171](#)
- [Configuration on page 173](#)
- [Verification on page 182](#)

---

### Requirements

This example uses the following hardware and software components:

- Three MX Series routers with MIC and MPC interfaces or three PTX Series Packet Transport Routers with PIC and FPC interfaces
- Junos OS Release 13.3 or later running on all devices

---

### Overview

Load balancing is required on the forwarding plane when there are multiple paths or interfaces available to the next hop router, and it is best if the incoming traffic is load balanced across all available paths for better link utilization.

Aggregated Ethernet bundle is a typical application that uses load balancing to balance traffic flows across the member links of the bundle (IEEE 802.3ad).

Starting with Junos OS Release 13.3, aggregated Ethernet load balancing is enhanced to provide two solutions for resolving genuine traffic imbalance on aggregated Ethernet bundles on MICs or MPCs of MX Series routers. Starting with Junos OS Release 14.1, aggregated Ethernet load balancing is enhanced to provide two solutions for resolving genuine traffic imbalance on aggregated Ethernet bundles on PICs or FPCs of PTX Series Packet Transport Routers.

The aggregated Ethernet load-balancing solutions are:

- **Adaptive**—Adaptive load balancing is used in scenarios where flow-based hashing is not sufficient to achieve a uniform load distribution. This load-balancing solution implements a real-time feedback and control mechanism to monitor and manage imbalances in network load.

The adaptive load-balancing solution corrects the traffic flow imbalance by modifying the selector entries, and periodically scanning the link utilization on each member link of the AE bundle to detect any deviations. When a deviation is detected, an adjustment event is triggered and fewer flows are mapped to the affected member link. As a result, the offered bandwidth of that member link goes down. This causes a continuous

feedback loop, which over a period of time ensures that the same amount of byte rate is offered to all the member links, thus providing efficient traffic distribution across each member link in the AE bundle.

To configure adaptive load balancing, include the **adaptive** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** Adaptive load balancing is not supported if the VLANID is configured on the aggregated Ethernet interface. This limitation affects the PTX Series Packet Transport Routers only.

The **pps** option enables load balancing based on the packets-per-second rate. The default setting is bits-per-second load balancing.

The **scan-interval** value configures the length of time for scanning as a multiple of 30 seconds.

The **tolerance** value is the limit to the variance in the packet traffic flow to the aggregated Ethernet links in the bundle. You can specify a maximum of 100-percent variance. When the tolerance attribute is not configured, a default value of 20 percent is enabled for adaptive load balancing. A smaller tolerance value balances better bandwidth, but takes a longer convergence time.



**NOTE:** The **pps** and **scan-interval** optional keywords are supported on PTX Series Packet Transport Routers only.

- Per-packet random spray—When the adaptive load-balancing solution fails, per-packet random spray acts as a last resort. The per-packet random spray load-balancing solution helps to address traffic imbalance by randomly spraying the packets to the aggregate next hops. This ensures that all the member links of the AE bundle are equally loaded, resulting in packet reordering.

In addition, per-packet random spray identifies the ingress Packet Forwarding Engine that caused the traffic imbalance and eliminates traffic imbalance that occurs as a result of software errors, except for packet hash.

To configure per-packet random spray load balancing, include the **per-packet** statement at the **[edit interfaces aex aggregated-ether-options load-balance]** hierarchy level.



**NOTE:** The Per-Packet option for load balancing is not supported on the PTX Series Packet Transport Routers.

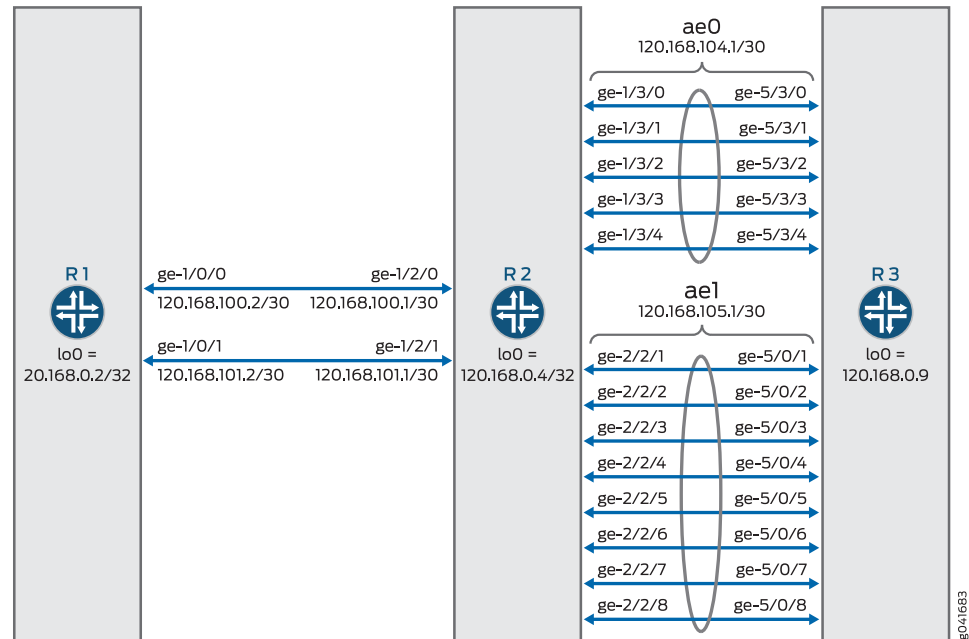
The aggregated Ethernet load-balancing solutions are mutually exclusive. When more than one of the load-balancing solutions is configured, the solution that is configured last overrides the previously configured one. You can verify the load-balancing solution being implemented by issuing the **show interfaces aex aggregated-ether-options load-balance** command.



### Topology

In this topology, two aggregated Ethernet bundles - ae0 and ae1 - are configured on the links between the R2 and R3 routers.

Figure 9: Aggregated Ethernet Load Balancing



### Configuration

#### CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
R1 set chassis aggregated-devices ethernet device-count 12
R1 set interfaces xe-0/0/0 unit 0 family inet address 120.168.1.1/30
R1 set interfaces xe-0/0/0 unit 0 family iso
R1 set interfaces xe-0/0/0 unit 0 family mpls
R1 set interfaces xe-0/0/1 unit 0 family inet address 120.168.2.1/30
R1 set interfaces xe-0/0/1 unit 0 family iso
R1 set interfaces xe-0/0/1 unit 0 family mpls
R1 set interfaces ge-1/0/0 unit 0 family inet address 120.168.100.2/30
R1 set interfaces ge-1/0/0 unit 0 family iso
R1 set interfaces ge-1/0/0 unit 0 family mpls
R1 set interfaces ge-1/0/1 unit 0 family inet address 120.168.101.2/30
R1 set interfaces ge-1/0/1 unit 0 family iso
R1 set interfaces ge-1/0/1 unit 0 family mpls
R1 set interfaces lo0 unit 0 family inet address 120.168.0.2/32
R1 set interfaces lo0 unit 0 family iso address 49.0001.1201.6800.0002.00
R1 set routing-options router-id 120.168.0.2
R1 set routing-options autonomous-system 55
R1 set protocols rsvp interface ge-1/0/0.0
R1 set protocols rsvp interface ge-1/0/1.0
```

```
set protocols mpls label-switched-path videl-to-sweets to 120.168.0.9
set protocols mpls label-switched-path v-2-s-601 to 60.0.1.0
set protocols mpls label-switched-path v-2-s-601 primary v-2-s-601-primary hop-limit
5
set protocols mpls label-switched-path v-2-s-602 to 60.0.2.0
set protocols mpls label-switched-path v-2-s-602 primary v-2-s-602-primary hop-limit
5
set protocols mpls label-switched-path v-2-s-603 to 60.0.3.0
set protocols mpls label-switched-path v-2-s-604 to 60.0.4.0
set protocols mpls path v-2-s-601-primary 120.168.100.1 strict
set protocols mpls path v-2-s-601-primary 120.168.104.2 strict
set protocols mpls path v-2-s-602-primary 120.168.101.1 strict
set protocols mpls path v-2-s-602-primary 120.168.105.2 strict
set protocols mpls interface ge-1/0/0.0
set protocols mpls interface ge-1/0/1.0
set protocols mpls interface xe-0/0/1.0
set protocols mpls interface xe-0/0/0.0
set protocols bgp group pe-routers type internal
set protocols bgp group pe-routers local-address 120.168.0.2
set protocols bgp group pe-routers family inet unicast
set protocols bgp group pe-routers family inet-vpn unicast
set protocols bgp group pe-routers neighbor 120.168.0.9
set protocols isis traffic-engineering family inet shortcuts
set protocols isis level 1 disable
set protocols isis interface ge-1/0/0.0
set protocols isis interface ge-1/0/1.0
set protocols isis interface lo0.0
set policy-options policy-statement nhs then next-hop self
set policy-options policy-statement vpn-m5-export term 1 from protocol bgp
set policy-options policy-statement vpn-m5-export term 1 from protocol direct
set policy-options policy-statement vpn-m5-export term 1 then community add
vpn-m5-target
set policy-options policy-statement vpn-m5-export term 1 then accept
set policy-options policy-statement vpn-m5-export term 2 then reject
set policy-options policy-statement vpn-m5-import term 1 from protocol bgp
set policy-options policy-statement vpn-m5-import term 1 from community vpn-m5-target
set policy-options policy-statement vpn-m5-import term 1 then accept
set policy-options policy-statement vpn-m5-import term 2 then reject
set policy-options community vpn-m5-target members target:55:100
set routing-instances vpn-m5 instance-type vrf
set routing-instances vpn-m5 interface xe-0/0/0.0
set routing-instances vpn-m5 interface xe-0/0/1.0
set routing-instances vpn-m5 route-distinguisher 120.168.0.2:1
set routing-instances vpn-m5 vrf-import vpn-m5-import
set routing-instances vpn-m5 vrf-export vpn-m5-export
set routing-instances vpn-m5 protocols bgp group ce type external
set routing-instances vpn-m5 protocols bgp group ce peer-as 100
set routing-instances vpn-m5 protocols bgp group ce as-override
set routing-instances vpn-m5 protocols bgp group ce neighbor 120.168.1.2
set routing-instances vpn-m5 protocols bgp group ce neighbor 120.168.2.2
set routing-instances vpn-m5 protocols ospf domain-id 1.0.0.0
set routing-instances vpn-m5 protocols ospf export vpn-m5-import
set routing-instances vpn-m5 protocols ospf area 0.0.0.0 interface xe-0/0/1.0
set routing-instances vpn-m5 protocols ospf area 0.0.0.0 interface xe-0/0/0.0
```

```

R2  set chassis aggregated-devices ethernet device-count 5
    set interfaces ge-1/2/0 unit 0 family inet address 120.168.100.1/30
    set interfaces ge-1/2/0 unit 0 family iso
    set interfaces ge-1/2/0 unit 0 family mpls
    set interfaces ge-1/2/1 unit 0 family inet address 120.168.101.1/30
    set interfaces ge-1/2/1 unit 0 family iso
    set interfaces ge-1/2/1 unit 0 family mpls
    set interfaces ge-1/3/0 gigether-options 802.3ad ae0
    set interfaces ge-1/3/1 gigether-options 802.3ad ae0
    set interfaces ge-1/3/2 gigether-options 802.3ad ae0
    set interfaces ge-1/3/3 gigether-options 802.3ad ae0
    set interfaces ge-1/3/4 gigether-options 802.3ad ae0
    set interfaces ge-2/2/1 gigether-options 802.3ad ae1
    set interfaces ge-2/2/2 gigether-options 802.3ad ae1
    set interfaces ge-2/2/3 gigether-options 802.3ad ae1
    set interfaces ge-2/2/4 gigether-options 802.3ad ae1
    set interfaces ge-2/2/5 gigether-options 802.3ad ae1
    set interfaces ge-2/2/6 gigether-options 802.3ad ae1
    set interfaces ge-2/2/7 gigether-options 802.3ad ae1
    set interfaces ge-2/2/8 gigether-options 802.3ad ae1
    set interfaces ae0 aggregated-ether-options load-balance adaptive tolerance 10
    set interfaces ae0 aggregated-ether-options link-speed 1g
    set interfaces ae0 aggregated-ether-options lacp active
    set interfaces ae0 unit 0 family inet address 120.168.104.1/30
    set interfaces ae0 unit 0 family iso
    set interfaces ae0 unit 0 family mpls
    set interfaces ae1 aggregated-ether-options load-balance adaptive tolerance 10
    set interfaces ae1 aggregated-ether-options link-speed 1g
    set interfaces ae1 aggregated-ether-options lacp active
    set interfaces ae1 unit 0 family inet address 120.168.105.1/30
    set interfaces ae1 unit 0 family iso
    set interfaces ae1 unit 0 family mpls
    set interfaces lo0 unit 0 family inet address 120.168.0.4/32
    set interfaces lo0 unit 0 family iso address 49.0001.1201.6800.0004.00
    set accounting-options selective-aggregate-interface-stats disable
    set protocols rsvp interface ge-1/2/0.0
    set protocols rsvp interface ge-1/2/1.0
    set protocols rsvp interface ae0.0
    set protocols rsvp interface ae1.0
    set protocols mpls interface ge-1/2/0.0
    set protocols mpls interface ge-1/2/1.0
    set protocols mpls interface ae0.0
    set protocols mpls interface ae1.0
    set protocols isis traffic-engineering family inet shortcuts
    set protocols isis level 1 disable
    set protocols isis interface ge-1/2/0.0
    set protocols isis interface ge-1/2/1.0
    set protocols isis interface ae0.0
    set protocols isis interface ae1.0
    set protocols isis interface lo0.0

R3  set chassis aggregated-devices ethernet device-count 5
    set interfaces xe-4/0/0 unit 0 family inet address 120.168.9.1/30
    set interfaces xe-4/0/0 unit 0 family mpls
    set interfaces xe-4/0/1 unit 0 family inet address 120.168.10.1/30

```

```
set interfaces xe-4/0/1 unit 0 family mpls
set interfaces ge-5/0/1 gigether-options 802.3ad ae1
set interfaces ge-5/0/2 gigether-options 802.3ad ae1
set interfaces ge-5/0/3 gigether-options 802.3ad ae1
set interfaces ge-5/0/4 gigether-options 802.3ad ae1
set interfaces ge-5/0/5 gigether-options 802.3ad ae1
set interfaces ge-5/0/6 gigether-options 802.3ad ae1
set interfaces ge-5/0/7 gigether-options 802.3ad ae1
set interfaces ge-5/0/8 gigether-options 802.3ad ae1
set interfaces ge-5/3/0 gigether-options 802.3ad ae0
set interfaces ge-5/3/1 gigether-options 802.3ad ae0
set interfaces ge-5/3/2 gigether-options 802.3ad ae0
set interfaces ge-5/3/3 gigether-options 802.3ad ae0
set interfaces ge-5/3/4 gigether-options 802.3ad ae0
set interfaces ae0 aggregated-ether-options link-speed 1g
set interfaces ae0 aggregated-ether-options lacp active
set interfaces ae0 unit 0 family inet address 120.168.104.2/30
set interfaces ae0 unit 0 family iso
set interfaces ae0 unit 0 family mpls
set interfaces ae1 aggregated-ether-options link-speed 1g
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 unit 0 family inet address 120.168.105.2/30
set interfaces ae1 unit 0 family iso
set interfaces ae1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 120.168.0.9/32
set interfaces lo0 unit 0 family iso address 49.0001.1201.6800.0009.00
set routing-options router-id 120.168.0.9
set routing-options autonomous-system 55
set protocols rsvp interface xe-4/0/0.0
set protocols rsvp interface xe-4/0/1.0
set protocols rsvp interface ae0.0
set protocols rsvp interface ae1.0
set protocols mpls label-switched-path to-videl to 120.168.0.2
set protocols mpls interface xe-4/0/0.0
set protocols mpls interface xe-4/0/1.0
set protocols mpls interface ae0.0
set protocols mpls interface ae1.0
set protocols bgp group pe-routers type internal
set protocols bgp group pe-routers local-address 120.168.0.9
set protocols bgp group pe-routers family inet unicast
set protocols bgp group pe-routers family inet-vpn unicast
set protocols bgp group pe-routers neighbor 120.168.0.2
set protocols isis traffic-engineering family inet shortcuts
set protocols isis level 1 disable
set protocols isis interface ae0.0
set protocols isis interface ae1.0
set protocols isis interface lo0.0
set policy-options policy-statement nhs then next-hop self
set policy-options policy-statement vpn-m5-export term 1 from protocol bgp
set policy-options policy-statement vpn-m5-export term 1 from protocol direct
set policy-options policy-statement vpn-m5-export term 1 then community add
    vpn-m5-target
set policy-options policy-statement vpn-m5-export term 1 then accept
set policy-options policy-statement vpn-m5-export term 2 then reject
set policy-options policy-statement vpn-m5-import term 1 from protocol bgp
set policy-options policy-statement vpn-m5-import term 1 from protocol direct
```

```

set policy-options policy-statement vpn-m5-import term 1 from community vpn-m5-target
set policy-options policy-statement vpn-m5-import term 1 then accept
set policy-options policy-statement vpn-m5-import term 2 then reject
set policy-options community vpn-m5-target members target:55:100
set routing-instances vpn-m5 instance-type vrf
set routing-instances vpn-m5 interface xe-4/0/0.0
set routing-instances vpn-m5 interface xe-4/0/1.0
set routing-instances vpn-m5 route-distinguisher 120.168.0.9:1
set routing-instances vpn-m5 vrf-import vpn-m5-import
set routing-instances vpn-m5 vrf-export vpn-m5-export
set routing-instances vpn-m5 protocols bgp group ce type external
set routing-instances vpn-m5 protocols bgp group ce peer-as 100
set routing-instances vpn-m5 protocols bgp group ce as-override
set routing-instances vpn-m5 protocols bgp group ce neighbor 120.168.9.2
set routing-instances vpn-m5 protocols bgp group ce neighbor 120.168.10.2
set routing-instances vpn-m5 protocols ospf domain-id 1.0.0.0
set routing-instances vpn-m5 protocols ospf export vpn-m5-import
set routing-instances vpn-m5 protocols ospf area 0.0.0.0 interface xe-4/0/0.0
set routing-instances vpn-m5 protocols ospf area 0.0.0.0 interface xe-4/0/1.0

```

### Configuring Adaptive Load Balancing

**Step-by-Step Procedure** The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

To configure the R2 router:



**NOTE:** Repeat this procedure for the other routers, after modifying the appropriate interface names, addresses, and any other parameters for each router.

- Specify the number of aggregated Ethernet interfaces to be created.  

```

[edit chassis]
user@R2# set aggregated-devices ethernet device-count 5

```
- Configure the Gigabit Ethernet interface link connecting R2 to R1.  

```

[edit interfaces]
user@R2# set ge-1/2/0 unit 0 family inet address 120.168.100.1/30
user@R2# set ge-1/2/0 unit 0 family iso
user@R2# set ge-1/2/0 unit 0 family mpls

user@R2# set ge-1/2/1 unit 0 family inet address 120.168.101.1/30
user@R2# set ge-1/2/1 unit 0 family iso
user@R2# set ge-1/2/1 unit 0 family mpls

user@R2# set lo0 unit 0 family inet address 120.168.0.4/32
user@R2# set lo0 unit 0 family iso address 49.0001.1201.6800.0004.00

```
- Configure the five member links of the ae0 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ge-1/3/0 gigether-options 802.3ad ae0
```

```
user@R2# set ge-1/3/1 gigether-options 802.3ad ae0
```

```
user@R2# set ge-1/3/2 gigether-options 802.3ad ae0
```

```
user@R2# set ge-1/3/3 gigether-options 802.3ad ae0
```

```
user@R2# set ge-1/3/4 gigether-options 802.3ad ae0
```

4. Configure the eight member links of the ae1 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ge-2/2/1 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/2 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/3 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/4 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/5 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/6 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/7 gigether-options 802.3ad ae1
```

```
user@R2# set ge-2/2/8 gigether-options 802.3ad ae1
```

5. Enable aggregate Ethernet load balancing on ae0 of R2.

```
[edit interfaces]
```

```
user@R2# set ae0 aggregated-ether-options load-balance adaptive tolerance 10
```

6. Configure the link speed for the ae0 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae0 aggregated-ether-options link-speed 1g
```

7. Configure LACP on the ae0 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae0 aggregated-ether-options lacp active
```

8. Configure the interface parameters for the ae0 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae0 unit 0 family inet address 120.168.104.1/30
```

```
user@R2# set ae0 unit 0 family iso
```

```
user@R2# set ae0 unit 0 family mpls
```

9. Enable aggregate Ethernet load balancing on ae1 of R2.

```
[edit interfaces]
```

```
user@R2# set ae1 aggregated-ether-options load-balance adaptive tolerance 10
```

10. Configure the link speed for the ae1 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae1 aggregated-ether-options link-speed 1g
```

11. Configure LACP on the ae1 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae1 aggregated-ether-options lacp active
```

12. Configure the interface parameters for the ae1 aggregated Ethernet bundle.

```
[edit interfaces]
```

```
user@R2# set ae1 unit 0 family inet address 120.168.105.1/30
```

```
user@R2# set ae1 unit 0 family iso
```

```
user@R2# set ae1 unit 0 family mpls
```

13. Disable selective aggregate Ethernet statistics.

```
[edit accounting-options]
user@R2# set selective-aggregate-interface-stats disable
```

14. Configure RSVP on all the interfaces of R2 and on the AE bundles.

```
[edit protocols]
user@R2# set rsvp interface ge-1/2/0.0
user@R2# set rsvp interface ge-1/2/1.0
user@R2# set rsvp interface ae0.0
user@R2# set rsvp interface ae1.0
```

15. Configure MPLS on all the interfaces of R2 and on the AE bundles.

```
[edit protocols]
user@R2# set mpls interface ge-1/2/0.0
user@R2# set mpls interface ge-1/2/1.0
user@R2# set mpls interface ae0.0
user@R2# set mpls interface ae1.0
```

16. Configure IS-IS on all the interfaces of R2 and on the AE bundles.

```
[edit protocols]
user@R2# set isis traffic-engineering family inet shortcuts
user@R2# set isis level 1 disable
user@R2# set isis interface ge-1/2/0.0
user@R2# set isis interface ge-1/2/1.0
user@R2# set isis interface ae0.0
user@R2# set isis interface ae1.0
user@R2# set isis interface lo0.0
```

### Results

From configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces**, **show accounting-options**, and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show chassis
aggregated-devices {
  ethernet {
    device-count 5;
  }
}

user@R2# show interfaces
ge-1/2/0 {
  unit 0 {
    family inet {
      address 120.168.100.1/30;
    }
    family iso;
    family mpls;
  }
}
ge-1/2/1 {
  unit 0 {
```

```
        family inet {
            address 120.168.101.1/30;
        }
        family iso;
        family mpls;
    }
}
ge-1/3/0 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-1/3/1 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-1/3/2 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-1/3/3 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-1/3/4 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-2/2/1 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/2 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/3 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/4 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/5 {
    gigether-options {
        802.3ad ae1;
    }
}
```



```
}
ge-2/2/6 {
  gigaether-options {
    802.3ad ae1;
  }
}
ge-2/2/7 {
  gigaether-options {
    802.3ad ae1;
  }
}
ge-2/2/8 {
  gigaether-options {
    802.3ad ae1;
  }
}
ae0 {
  aggregated-ether-options {
    load-balance {
      adaptive tolerance 10;
    }
    link-speed 1g;
    lacp {
      active;
    }
  }
  unit 0 {
    family inet {
      address 120.168.104.1/30;
    }
    family iso;
    family mpls;
  }
}
ae1 {
  aggregated-ether-options {
    load-balance {
      adaptive tolerance 10;
    }
    link-speed 1g;
    lacp {
      active;
    }
  }
  unit 0 {
    family inet {
      address 120.168.105.1/30;
    }
    family iso;
    family mpls;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 120.168.0.4/32;
    }
  }
}
```

```
    }
    family iso {
        address 49.0001.1201.6800.0004.00;
    }
}

user@R2# show accounting-options
selective-aggregate-interface-stats disable;

user@R2# show protocols
rsvp {
    interface ge-1/2/0.0;
    interface ge-1/2/1.0;
    interface ae0.0;
    interface ae1.0;
}
mpls {
    interface ge-1/2/0.0;
    interface ge-1/2/1.0;
    interface ae0.0;
    interface ae1.0;
}
isis {
    traffic-engineering {
        family inet {
            shortcuts;
        }
    }
    level 1 disable;
    interface ge-1/2/0.0;
    interface ge-1/2/1.0;
    interface ae0.0;
    interface ae1.0;
    interface lo0.0;
}
```

---

### Verification

Confirm that the configuration is working properly.

- [Verifying Adaptive Load Balancing on ae0 on page 182](#)

#### ***Verifying Adaptive Load Balancing on ae0***

**Purpose** Verify that packets received on the ae0 aggregated Ethernet bundle are load-balanced among the five member links.

**Action** From operational mode, run the **show interfaces ae0 extensive** command.

```

user@R2> show interfaces ae0 extensive
Logical interface ae0.0 (Index 325) (SNMP ifIndex 917) (Generation 134)
Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2
Statistics          Packets          pps          Bytes          bps
Bundle:
  Input :           848761           9       81247024       7616
  Output: 166067308909    3503173 126900990064983 21423804256
Adaptive Statistics:
  Adaptive Adjusts:      264
  Adaptive Scans :     27682
  Adaptive Updates:      10
Link:
  ge-1/3/0.0
    Input :           290888           5       29454436       3072
    Output: 33183442699    704569 25358563587277 4306031760
  ge-1/3/1.0
    Input :           162703           1       14806325        992
    Output: 33248375409    705446 25406995966732 4315342152
  ge-1/3/2.0
    Input :           127448           1       12130566        992
    Output: 33184552729    697572 25354827700261 4267192376
  ge-1/3/3.0
    Input :           121044           1       11481262       1280
    Output: 33245875402    697716 25405953405192 4265750584
  ge-1/3/4.0
    Input :           146678           1       13374435       1280
    Output: 33205071207    697870 25374651121458 4269487384

```

**Meaning** The member links of the ae0 aggregated Ethernet bundle are fully utilized with adaptive load balancing.

## Stateful Load Balancing for Aggregated Ethernet Interfaces Using 5-Tuple Data

---

When multiple flows are transmitted out of an aggregated Ethernet (**ae**) interface, the flows must be distributed across the different member links evenly to enable an effective and optimal load-balancing behavior. To obtain a streamlined and robust method of load-balancing, the member link of the aggregated Ethernet interface bundle that is selected each time for load balancing plays a significant part. In Junos OS releases earlier than Release 13.2R1, on MX Series routers with Trio-based FPCs (MPCs), the selection of a member link of the **ae** interface bundle or the next-hop (or unilist of next-hops) for equal-cost multipath (ECMP) links is performed using a balanced mode next-hop selection methodology and an unbalanced mode of member link or next-hop selection methodology. The balanced mode of link selection uses 'n' bits in a precomputed hash value if it needs to select one of  $2^n$  ( $2$  raised to the power of  $n$ ) next-hop in the unilist. The unbalanced mode of member-link or next-hop selection uses 8 bits in a precomputed hash to select an entry in a selector table, which is randomly done with the member link IDs of the link aggregation group (LAG) or **aebundle**.

The term balanced versus unbalanced indicates whether a selector table is used for load balancing mechanism or not. The LAG bundle uses the unbalanced mode (selector table balancing) to balance the traffic across member links. When the traffic flows are minimal, the following problems might occur with the unbalanced mode: The link selection logic utilizes only subset bits of the precomputed hash. Regardless of the efficiency of the hashing algorithm, it is only the compressed representation of a flow. Because the inter-flow variance is very low, the resultant hashes and the subset that are computed do not provide the necessary variability to effectively utilize all the LAG member links. An excessive amount of random nature exists in the hash computation and also in the selector table. As a result, the deviation from being an optimal load-balancing technique for each child link that is selected is higher when the number of flows is lower.

The deviation per child link is defined as

$$V_i = ((C_i - (M/N))) / N$$

where

- $V_i$  denotes the deviation for that child link 'i'.
- $i$  denotes the child link member/index.
- $C_i$  represents the packets transmitted for that child link 'i'.
- $M$  signifies the total packets transmitted on that LAG bundle.
- $N$  denotes the number of child links in that LAG.

Because of these drawbacks, for smaller number of flows, or flows with less inter-flow variance, the link utilization is skewed, and a high probability of a few child links not being utilized entirely exists. Starting with Junos OS Release 13.2R1, the capability to perform uniform load balancing and also perform rebalancing is introduced on MX Series routers with MPCs, except MPC3Es and MPC4Es. Rebalancing is not supported when load-balancing is skewed or distorted owing to a change in the number of flows.

The mechanism to record and retain states for the flows and distribute the traffic load accordingly is added. As a result, for  $m$  number of flows, they are distributed among  $n$  member links of a LAG bundle or among the unilist of next-hops in an ECMP link. This method of splitting the load among member links is called *stateful load balancing* and it uses 5-tuple information (source and destination addresses, protocol, source and destination ports). Such a method can be mapped directly to the flows, or to a precompute hash based on certain fields in the flow. As a result, the deviation observed on each child link is reduced.

This mechanism works efficiently only for minimal number of flows (less than thousands of flows, approximately). For a larger number of flows (between 1000 and 10,000 flows), we recommend that distributed Trio-based load-balancing mechanism is used.

Consider a sample scenario in which ' $n$ ' links in the LAG are identified with link IDs of 0 through  $n-1$ . A hash table or a flow table is used to record the flows as and when they show up. The hashing key is constructed using the fields that uniquely identify a flow. The result of the lookup identifies the `link_id` that the flow is currently using. For each packet, the flow table based on the flow identifier is examined. If a match is found, it denotes a packet that belongs to a flow that is previously processed or detected. The link ID is associated with the flow. If a match is not found, it is the first packet that belongs to the flow. The link ID is used to select the link and the flow is inserted into the flow table.

To enable per-flow load balancing based on hash values, include the **per-flow** statement at the `[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]` hierarchy level. By default, Junos OS uses a hashing method based only on the destination address to elect a forwarding next hop when multiple equal-cost paths are available. All Packet Forwarding Engine slots are assigned the same hash value by default. To configure the load-balancing algorithm to dynamically rebalance the LAG using existing parameters, include the **rebalance interval** statement at the `[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]` hierarchy level. This parameter periodically load balances traffic by providing a synchronized rebalance switchover across all the ingress Packet Forwarding Engines (PFEs) over a rebalance interval. You can specify the interval as a value in the range of 1 through 1000 flows per minute. To configure the load type, include the **load-type (low | medium | high)** statement at the `[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]` hierarchy level.

The **stateful per-flow** option enables the load-balancing capability on AE bundles. The **rebalance** option clears the load balance state at specified intervals. The **load** option informs the Packet Forwarding Engine regarding the appropriate memory pattern to be used. If the number of flows that flow on this aggregated Ethernet interface is less (between 1 and 100 flows), then the **low** keyword can be used. Similarly for relatively higher flows (between 100 and 1000 flows), the **medium** keyword can be used and the **large** keyword can be used for the maximum flows (between 1000 and 10,000 flows). The approximate number of flows for effective load-balancing for each keyword is a derivative.

The **clear interfaces aeX unit logical-unit-number forwarding-options load-balance state** command clears the load balance state at the hardware level and enables rebalancing

from the cleaned up, empty state. This clear state is triggered only when you use this command. The **clear interfaces aggregate forwarding-options load-balance state** command clears all the aggregate Ethernet interface load balancing states and re-creates them newly.

## Guidelines for Configuring Stateful Load Balancing for Aggregated Ethernet Interfaces or LAG Bundles

Keep the following points in mind while configuring stateful load-balancing for aggregated Ethernet interfaces:

- When a child link is removed or added, a new aggregate selector is selected and traffic flows onto the new selector. Because the selector is empty, flows are filled in the selector. This behavior causes redistribution of flows because the old state is lost. This is the existing behavior without enabling stateful per-flow load-balancing.
- Stateful per-flow load-balancing functions on AE interfaces if the incoming traffic reaches the MPC1E, MPC2E, MPC3E-3D, MPC5E, and MPC6E line cards. Any other type of line card does not trigger this functionality. Appropriate CLI errors are displayed if the MPCs do not support this capability.

With the ingress line card as MPC and the egress line card as MPC or DPC, this feature works properly. Stateful load-balancing is not supported if the ingress line card is a DPC and the egress line card is a DPC or an MPC.

- This capability is not supported for multicast traffic (native/flood).
- Enabling the rebalance option or clearing the load balance state can cause packet reordering for active flows because different sets of links can be selected for traffic flows.
- Although the feature performance is high, it consumes significant amount of line card memory. Approximately, 4000 logical interfaces or 16 aggregated Ethernet logical interfaces can have this feature enabled on supported MPCs. However, when the Packet Forwarding Engine hardware memory is low, depending upon the available memory, it falls back to the default load balancing mechanism. A system logging message is generated in such a situation and sent to the Routing Engine. A restriction on the number of AE interfaces that support stateful load-balancing does not exist; the limit is determined by the line cards.
- If the traffic flows become aged frequently, then the device needs to remove or refresh the load balancing states. As a result, you must configure rebalancing or run the clear command at periodic intervals for proper load-balancing. Otherwise, traffic skewing can occur. When a child link goes down or comes up, the load balancing behavior does not undergo changes on existing flows. This condition is to avoid packet reordering. New flows pick up the child link that come up. If you observe load distribution to be not very effective, you can clear the load-balancing states or use rebalancing functionality to cause an automatic clearance of the hardware states. When you configure the rebalancing facility, traffic flows can get redirected to different links, which can cause packet reordering.

### Related Documentation

- [Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187](#)

## Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces

The mechanism to record and retain states for the flows and distribute the traffic load accordingly is added. As a result, for  $m$  number of flows, they are distributed among  $n$  member links of a LAG bundle or among the unilist of next-hops in an ECMP link. This method of splitting the load among member links is called *stateful load balancing* and it uses 5-tuple information (source and destination addresses, protocol, source and destination ports). Such a method can be mapped directly to the flows, or to a precompute hash based on certain fields in the flow. As a result, the deviation observed on each child link is reduced.

To configure stateful load balancing on **ae** interface bundles:

1. Specify that you want to configure an aggregated Ethernet interface.

**[edit]**

**user@R2# set interfaces aeX unit *logical-unit-number***

2. Specify that you want to configure stateful load-balancing.

**[edit interfaces aeX unit *logical-unit-number*]**

**user@R2# edit forwarding-options load-balance-stateful**

3. Enable the mechanism to perform an even, effective distribution of traffic flows across member links of an aggregated Ethernet interface (**ae**) bundle on MX Series routers with MPCs, except MPC3Es and MPC4Es.

**[edit interfaces aeX unit *logical-unit-number* load-balance-stateful]**

**user@R2# set per-flow**

4. Configure periodic rebalancing of traffic flows of an aggregated Ethernet bundle by clearing the load balance state at a specified interval.

**[edit interfaces aeX unit *logical-unit-number* load-balance-stateful]**

**user@R2# set rebalance *interval***

5. Define the load-balancing type to inform the Packet Forwarding Engine regarding the appropriate memory pattern to be used for traffic flows. The approximate number of flows for effective load-balancing for each keyword is a derivative.

**[edit interfaces aeX unit *logical-unit-number* load-balance-stateful]**

**user@R2# set load-type (low | medium | large)**

6. Configure the address family and IP address for the **ae** interface.

**[edit interfaces]**

**user@R2# set ae0 aggregated-ether-options load-balance adaptive tolerance 10**

7. Configure the link speed for the ae0 aggregated Ethernet bundle.

**[edit interfaces aeX unit *logical-unit-number*]**

**user@R2# set family *family-name* address *address***

### Related Documentation

- [Stateful Load Balancing for Aggregated Ethernet Interfaces Using 5-Tuple Data on page 184](#)

## Configuring Adaptive Load Balancing

---

This topic describes how to configure adaptive load balancing. Adaptive load balancing maintains efficient utilization of member link bandwidth for an aggregated Ethernet (AE) bundle. Adaptive load balancing uses a feedback mechanism to correct traffic load imbalance by adjusting the bandwidth and packet streams on links within an AE bundle.

Before you begin:

- Configure a set of interfaces with a protocol family and IP address. These interfaces can make up the membership for the AE bundle.
- Create an AE bundle by configuring a set of router interfaces as aggregated Ethernet and with a specific AE group identifier.

To configure adaptive load balancing for an AE bundles:

1. Enable adaptive load balancing on the AE bundle:

```
[edit interfaces ae-x aggregated-ether-options load-balance]
user@router# set adaptive
```

2. Configure the scan interval value for adaptive load balancing on the AE bundle. The scan interval value determines the length of the traffic scan by multiplying the integer value with a 30-second time period:

```
[edit interfaces ae-x aggregated-ether-options load-balance adaptive]
user@router# set scan-interval multiplier
```

3. Configure the tolerance percentage value. The tolerance value determines the allowed deviation in the traffic rates among the members of the AE bundle before the router triggers an adaptive load balancing update:

```
[edit interfaces ae-x aggregated-ether-options load-balance adaptive]
user@router# set tolerance percentage
```

4. (Optional) Enable packet-per-second-based adaptive load balancing on the AE bundle:

```
[edit interfaces ae-x aggregated-ether-options load-balance adaptive]
user@router# set pps
```

### Related Documentation

- [Understanding Aggregated Ethernet Load Balancing on page 166](#)
- [Example: Configuring Aggregated Ethernet Load Balancing on page 171](#)
- [adaptive on page 862](#)



## Understanding Independent Micro BFD Sessions for LAG

---

Starting with Junos OS Release 13.3, this feature is supported on the following PIC/FPC types:

- PC-1XGE-XENPAK (Type 3 FPC)
- PD-4XGE-XFP (Type 4 FPC)
- PD-5-10XGE-SFPP (Type 4 FPC)
- 24x10GE (LAN/WAN) SFPP, 12x10GE (LAN/WAN) SFPP, 1x100GE Type 5 PICs
- All MPCs on MX Series with Ethernet MICs
- FPC-PTX-P1-A on PTX5000 with 10-Gigabit Ethernet interfaces
- FPC2-PTX-P1A on PTX5000 with 10-Gigabit Ethernet interfaces in Junos OS Release 14.1 and later
- All FPCs on PTX Series with Ethernet interfaces in Junos OS Release 14.1R3 and later 14.1 releases, and Junos OS Release 14.2 and later



**TIP:** See *PTX Series PIC/FPC Compatibility* for a list of PICs that are supported on each PTX Series FPC.

---

The Bidirectional Forwarding Detection (BFD) protocol is a simple detection protocol that quickly detects failures in the forwarding paths. A link aggregation group (LAG) combines multiple links between devices that are in point-to-point connections thereby increasing bandwidth, providing reliability, and allowing load balancing. To run a BFD session on LAG interfaces, configure an independent asynchronous mode BFD session on every LAG member link in a LAG bundle. Instead of a single BFD session monitoring the status of the UDP port, independent micro BFD sessions monitor the status of individual member links.

The individual BFD sessions determine the Layer 2 and Layer 3 connectivity of each of the member links in the LAG. Once a BFD session is established on a particular link, the member links are attached to the LAG and the load balancer either by a static configuration or by the Link Aggregation Control Protocol (LACP). If the member links are attached to the LAG by a static configuration, the device control process acts as the client to the micro BFD session. When member links are attached to the LAG by the LACP, the LACP acts as the client to the micro BFD session.

When the micro BFD session is up, a LAG link is established and data is transmitted over that LAG link. If the micro BFD session on a member link is down, that particular member link is removed from the load balancer, and the LAG managers stop directing traffic to that link. These micro BFD sessions are independent of each other despite having a single client that manages the LAG interface.



**NOTE:** IANA has allocated 01-00-5E-90-00-01 as the dedicated MAC address for micro BFD. Dedicated MAC mode is used by default for micro BFD sessions, in accordance with the latest draft for BFD over LAG.

---

Micro BFD sessions run in the following modes:

- **Distribution Mode**—Micro BFD sessions are distributed by default at Layer 3.
- **Non-Distribution Mode**—You can configure the BFD session to run in this mode by including the **no-delegate-processing** statement under periodic packet management (PPM). In this mode the packets are being sent or received by the Routing Engine at Layer 2.

A pair of routing devices in a LAG exchange BFD packets at a specified, regular interval. The routing device detects a neighbor failure when it stops receiving a reply after a specified interval. This allows the quick verification of member link connectivity with or without LACP. A UDP port distinguishes BFD over LAG packets from BFD over single-hop IP.



**NOTE:** IANA has allocated 6784 as the UDP destination port for micro BFD.

To enable failure detection for LAG networks for aggregated Ethernet interfaces:

- Include the **bfd-liveness-detection** statement in the configuration.
- Specify a hold-down interval value to set the minimum time that the BFD session must remain up before a state change notification is sent to the other members in the LAG network.
- Specify the minimum interval that indicates the time interval for transmitting and receiving data.
- Specify the neighbor in a BFD session. The BFD neighbor address is the loopback address of the remote destination of the BFD session. The neighbor address can be either an IPv4 or an IPv6 address.



**NOTE:** This feature works only when both the devices support BFD. If BFD is configured at one end of the LAG, this feature does not work.

#### Related Documentation

- *authentication*
- [bfd-liveness-detection on page 899](#)
- *detection-time*
- *transmit-interval*
- *Configuring Independent Micro BFD Sessions for LAG*
- [Example: Configuring Independent Micro BFD Sessions for LAG on page 192](#)

## Example: Configuring Independent Micro BFD Sessions for LAG

This example shows how to configure an independent micro BFD session for aggregated Ethernet interfaces.

- [Requirements on page 192](#)
- [Overview on page 192](#)
- [Configuration on page 192](#)
- [Verification on page 198](#)

### Requirements

This example uses the following hardware and software components:

- MX Series routers with Junos Trio chipset.
- T Series routers with Type 4 FPC or Type 5 FPC.
- Junos OS Release 13.3 or later running on all devices.

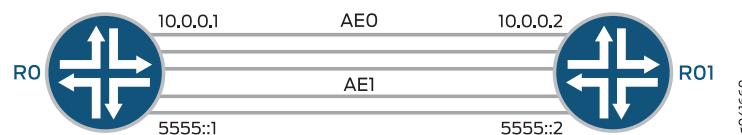
### Overview

The example includes two routers that are directly connected. Configure two aggregated Ethernet interfaces AE0 and AE1 that are assigned four and two IP addresses respectively. Configure BFD sessions on the aggregated Ethernet interfaces on both ends of the connection. This example verifies that independent micro BFD sessions are active in the output.

### Topology

Figure 10 on page 192 shows the sample topology.

Figure 10: Configuring Independent Micro BFD Session for LAG



### Configuration

#### CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```

Router R0
set interfaces ge-1/0/1 unit 0 family inet address 20.20.20.1/30
set interfaces ge-1/0/1 unit 0 family inet6 address 3ffe::1/126
set interfaces xe-4/0/0 gigether-options 802.3ad ae0
set interfaces xe-4/0/1 gigether-options 802.3ad ae0
set interfaces xe-4/1/0 gigether-options 802.3ad ae1
set interfaces xe-4/1/1 gigether-options 802.3ad ae1
set interfaces lo0 unit 0 family inet address 10.255.106.107/32
  
```

```

set interfaces lo0 unit 0 family inet6 address 201:DB8:251::aa:aa:1/126
set interfaces ae0 aggregated-ether-options bfd-liveness-detection minimum-interval
  100
set interfaces ae0 aggregated-ether-options bfd-liveness-detection neighbor
  10.255.106.102
set interfaces ae0 aggregated-ether-options bfd-liveness-detection local-address
  10.255.106.107
set interfaces ae0 aggregated-ether-options minimum-links 1
set interfaces ae0 aggregated-ether-options link-speed 10g
set interfaces ae0 aggregated-ether-options lacp active
set interfaces ae0 unit 0 family inet address 10.0.0.1/30
set interfaces ae0 unit 0 family inet address 10.0.0.5/30
set interfaces ae0 unit 0 family inet address 10.0.0.9/30
set interfaces ae0 unit 0 family inet address 10.0.0.13/30
set interfaces ae0 unit 0 family inet6 address 1111::1/126
set interfaces ae0 unit 0 family inet6 address 2222::1/126
set interfaces ae0 unit 0 family inet6 address 3333::1/126
set interfaces ae0 unit 0 family inet6 address 4444::1/126
set interfaces ae1 aggregated-ether-options bfd-liveness-detection minimum-interval
  100
set interfaces ae1 aggregated-ether-options bfd-liveness-detection multiplier 3
set interfaces ae1 aggregated-ether-options bfd-liveness-detection neighbor
  201:DB8:251::bb:bb:1
set interfaces ae1 aggregated-ether-options bfd-liveness-detection local-address
  201:DB8:251::aa:aa:1
set interfaces ae1 aggregated-ether-options minimum-links 1
set interfaces ae1 aggregated-ether-options link-speed 10g
set interfaces ae1 unit 0 family inet address 50.0.0.1/30
set interfaces ae1 unit 0 family inet address 51.0.0.1/29
set interfaces ae1 unit 0 family inet6 address 5555::1/126
set interfaces ae1 unit 0 family inet6 address 6666::1/126
set routing-options nonstop-routing
set routing-options static route 30.30.30.0/30 next-hop 10.0.0.2
set routing-options rib inet6.0 static route 3ffe::1:2/126 next-hop 1111::2
set protocols bfd traceoptions file bfd
set protocols bfd traceoptions file size 100m
set protocols bfd traceoptions file files 10
set protocols bfd traceoptions flag all

```

```

Router R1
set interfaces xe-0/0/0 gigether-options 802.3ad ae0
set interfaces xe-0/0/1 gigether-options 802.3ad ae0
set interfaces xe-0/0/2 gigether-options 802.3ad ae1
set interfaces xe-0/0/3 gigether-options 802.3ad ae1
set interfaces ge-1/1/8 unit 0 family inet address 30.30.30.1/30
set interfaces ge-1/1/8 unit 0 family inet6 address 3ffe::1:2/126
set interfaces lo0 unit 0 family inet address 10.255.106.102/32
set interfaces lo0 unit 0 family inet6 address 201:DB8:251::bb:bb:1/126
set interfaces ae0 aggregated-ether-options bfd-liveness-detection minimum-interval
  150
set interfaces ae0 aggregated-ether-options bfd-liveness-detection neighbor
  10.255.106.107
set interfaces ae0 aggregated-ether-options bfd-liveness-detection local-address
  10.255.106.102
set interfaces ae0 unit 0 family inet address 10.0.0.2/30
set interfaces ae0 unit 0 family inet address 10.0.0.6/30
set interfaces ae0 unit 0 family inet address 10.0.0.10/30

```

```

set interfaces ae0 unit 0 family inet address 10.0.0.14/30
set interfaces ae0 unit 0 family inet6 address 1111::2/126
set interfaces ae0 unit 0 family inet6 address 2222::2/126
set interfaces ae0 unit 0 family inet6 address 3333::2/126
set interfaces ae0 unit 0 family inet6 address 4444::2/126
set interfaces ae0 aggregated-ether-options minimum-links 2
set interfaces ae0 aggregated-ether-options link-speed 10g
set interfaces ae0 aggregated-ether-options lacp passive
set interfaces ae0 unit 0 family inet address 10.0.0.2/30
set interfaces ae1 aggregated-ether-options bfd-liveness-detection minimum-interval
  200
set interfaces ae1 aggregated-ether-options bfd-liveness-detection multiplier 3
set interfaces ae1 aggregated-ether-options bfd-liveness-detection neighbor
  201:DB8:251::aa:aa:1
set interfaces ae1 aggregated-ether-options bfd-liveness-detection local-address
  201:DB8:251::bb:bb:1
set interfaces ae1 aggregated-ether-options minimum-links 1
set interfaces ae1 aggregated-ether-options link-speed 10g
set interfaces ae1 unit 0 family inet address 50.0.0.2/30
set interfaces ae1 unit 0 family inet address 51.0.0.2/29
set interfaces ae1 unit 0 family inet6 address 5555::2/126
set interfaces ae1 unit 0 family inet6 address 6666::2/126
set routing-options static route 20.20.20.0/30 next-hop 10.0.0.1
set routing-options rib inet6.0 static route 3ffe::1/126 next-hop 1111::1

```

### Configuring Micro BFD Session for Aggregated Ethernet Interfaces

#### Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.



**NOTE:** Repeat this procedure for Router R1, modifying the appropriate interface names, addresses, and any other parameters for each router.

To configure micro BFD session for aggregated Ethernet interfaces on Router R0:

1. Configure the physical interfaces.

```

[edit interfaces]
user@R0# set ge-1/0/1 unit 0 family inet address 20.20.20.1/30
user@R0# set ge-1/0/1 unit 0 family inet6 address 3ffe::1/126
user@R0# set xe-4/0/0 gigether-options 802.3ad ae0
user@R0# set xe-4/0/1 gigether-options 802.3ad ae0
user@R0# set xe-4/1/0 gigether-options 802.3ad ae1
user@R0# set xe-4/1/1 gigether-options 802.3ad ae1

```

2. Configure the loopback interface.

```

[edit interfaces]
user@R0# set lo0 unit 0 family inet address 10.255.106.107/32
user@R0# set lo0 unit 0 family inet6 address 201:DB8:251::aa:aa:1/128

```

3. Configure four IP addresses on the aggregated Ethernet interface ae0 with either IPv4 or IPv6 addresses, as per your network requirements.

[edit interfaces]

```
user@R0# set ae0 unit 0 family inet address 10.0.0.1/30
user@R0# set ae0 unit 0 family inet address 10.0.0.5/30
user@R0# set ae0 unit 0 family inet address 10.0.0.9/30
user@R0# set ae0 unit 0 family inet address 10.0.0.13/30
```

```
user@R0# set ae0 unit 0 family inet6 address 1111::1/126
user@R0# set ae0 unit 0 family inet6 address 2222::1/126
user@R0# set ae0 unit 0 family inet6 address 3333::1/126
user@R0# set ae0 unit 0 family inet6 address 4444::1/126
```

4. Set the routing option, create a static route, and set the next-hop address.



**NOTE:** You can configure either an IPv4 or IPv6 static route depending on your network requirements.

[edit routing-options]

```
user@R0# set nonstop-routing
user@R0# set static route 30.30.30.0/30 next-hop 10.0.0.2
user@R0# set rib inet6.0 static route 3ffe::1:2/126 next-hop 1111::2
```

5. Configure the Link Aggregation Control Protocol (LACP).

[edit interfaces]

```
user@R0# set ae0 aggregated-ether-options lacp active
```

6. Configure BFD for the aggregated Ethernet interface ae0 and specify the minimum interval, local IP address, and the neighbor IP address.

[edit interfaces]

```
user@R0# set ae0 aggregated-ether-options bfd-liveness-detection
  minimum-interval 100
user@R0# set ae0 aggregated-ether-options bfd-liveness-detection neighbor
  10.255.106.102
user@R0# set ae0 aggregated-ether-options bfd-liveness-detection local-address
  10.255.106.107
user@R0# set ae0 aggregated-ether-options minimum-links 1
user@R0# set ae0 aggregated-ether-options link-speed 10g
```

7. Configure two IP addresses on the aggregated Ethernet interface ae1.

You can assign either IPv4 or IPv6 addresses as per your network requirements.

[edit interfaces]

```
user@R0# set ae1 unit 0 family inet address 50.0.0.1/30
user@R0# set ae1 unit 0 family inet address 51.0.0.1/29
```

```
user@R0# set ae1 unit 0 family inet6 address 5555::1/126
user@R0# set ae1 unit 0 family inet6 address 6666::1/126
```

8. Configure BFD for the aggregated Ethernet interface ae1.

[edit interfaces]

```

user@R0# set ae1 aggregated-ether-options bfd-liveness-detection
minimum-interval 100
user@R0# set ae1 aggregated-ether-options bfd-liveness-detection multiplier 3
user@R0# set ae1 aggregated-ether-options bfd-liveness-detection neighbor
201:DB8:251::bb:bb:1
user@R0# set ae1 aggregated-ether-options bfd-liveness-detection local-address
201:DB8:251::aa:aa:1
user@R0# set ae1 aggregated-ether-options minimum-links 1
user@R0# set ae1 aggregated-ether-options link-speed 10g

```

9. Configure tracing options for BFD for troubleshooting.

```

[edit protocols]
user@R0# set bfd traceoptions file bfd
user@R0# set bfd traceoptions file size 100m
user@R0# set bfd traceoptions file files 10
user@R0# set bfd traceoptions flag all

```

## Results

From configuration mode, enter the **show interfaces**, **show protocols**, and **show routing-options** commands and confirm your configuration. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```

user@R0> show interfaces
traceoptions {
  flag bfd-events;
}
ge-1/0/1 {
  unit 0 {
    family inet {
      address 20.20.20.1/30;
    }
    family inet6 {
      address 3ffe::1:1/126;
    }
  }
}
xe-4/0/0 {
  enable;
  gigether-options {
    802.3ad ae0;
  }
}
xe-4/0/1 {
  gigether-options {
    802.3ad ae0;
  }
}
xe-4/1/0 {
  enable;
  gigether-options {
    802.3ad ae1;
  }
}

```



```
xe-4/1/1 {
  gigether-options {
    802.3ad ae1;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 10.255.106.107/32;
    }
    family inet6 {
      address 201:DB8:251::aa:aa:1/128;
    }
  }
}
ae0 {
  aggregated-ether-options {
    bfd-liveness-detection {
      minimum-interval 100;
      neighbor 10.255.106.102;
      local-address 10.255.106.107;
    }
    minimum-links 1;
    link-speed 10g;
    lacp {
      active;
    }
  }
}
unit 0 {
  family inet {
    address 10.0.0.1/30;
    address 10.0.0.5/30;
    address 10.0.0.9/30;
    address 10.0.0.13/30;
  }
  family inet6 {
    address 1111::1/126;
    address 2222::1/126;
    address 3333::1/126;
    address 4444::1/126;
  }
}
}
ae1 {
  aggregated-ether-options {
    bfd-liveness-detection {
      minimum-interval 100;
      multiplier 3;
      neighbor 201:DB8:251::bb:bb:1;
      local-address 201:DB8:251::aa:aa:1;
    }
    minimum-links 1
    link-speed 10g;
  }
}
unit 0 {
  family inet {
```

```
        address 50.0.0.1/30;
        address 51.0.0.1/29;
    }
    family inet6 {
        address 5555::1/126;
        address 6666::1/126;
    }
}

user@R0> show protocols
bfd {
  traceoptions {
    file bfd size 100m files 10;
    flag all;
  }
}

user@R0> show routing-options
nonstop-routing ;
rib inet6.0 {
  static {
    route 3ffe:1:2/126 {
      next-hop 1111::2;
    }
  }
}
static {
  route 30.30.30.0/30 {
    next-hop 10.0.0.2;
  }
}
```

If you are done configuring the device, commit the configuration.

```
user@R0# commit
```

## Verification

Confirm that the configuration is working properly.

- [Verifying That the Independent BFD Sessions Are Up on page 198](#)
- [Viewing Detailed BFD Events on page 200](#)

### Verifying That the Independent BFD Sessions Are Up

**Purpose** Verify that the micro BFD sessions are up, and view details about the BFD sessions.

**Action** From operational mode, enter the **show bfd session extensive** command

```
user@R0> show bfd session extensive
```

Address	State	Interface	Detect Time	Transmit Interval	Multiplier
10.255.106.102	Up	xe-4/0/0	9.000	3.000	3

```
Client LACPD, TX interval 0.100, RX interval 0.100
Session up time 4d 23:13, previous down time 00:00:06
Local diagnostic None, remote diagnostic None
Remote heard, hears us, version 1
Replicated
Session type: Micro BFD
Min async interval 0.100, min slow interval 1.000
Adaptive async TX interval 0.100, RX interval 0.100
Local min TX interval 0.100, minimum RX interval 0.100, multiplier 3
Remote min TX interval 3.000, min RX interval 3.000, multiplier 3
Local discriminator 21, remote discriminator 75
Echo mode disabled/inactive
Remote is control-plane independent
Session ID: 0x0
```

Address	State	Interface	Detect Time	Transmit Interval	Multiplier
10.255.106.102	Up	xe-4/0/1	9.000	3.000	3

```
Client LACPD, TX interval 0.100, RX interval 0.100
Session up time 4d 23:13, previous down time 00:00:07
Local diagnostic None, remote diagnostic None
Remote heard, hears us, version 1
Replicated
Session type: Micro BFD
Min async interval 0.100, min slow interval 1.000
Adaptive async TX interval 0.100, RX interval 0.100
Local min TX interval 0.100, minimum RX interval 0.100, multiplier 3
Remote min TX interval 3.000, min RX interval 3.000, multiplier 3
Local discriminator 19, remote discriminator 74
Echo mode disabled/inactive
Remote is control-plane independent
Session ID: 0x0
```

Address	State	Interface	Detect Time	Transmit Interval	Multiplier
201:DB8:251::bb:bb:1	Up	xe-4/1/1	9.000	3.000	3

```
Client LACPD, TX interval 0.100, RX interval 0.100
Session up time 4d 23:13
Local diagnostic None, remote diagnostic None
Remote not heard, hears us, version 1
Replicated
Session type: Micro BFD
Min async interval 0.100, min slow interval 1.000
Adaptive async TX interval 0.100, RX interval 0.100
Local min TX interval 1.000, minimum RX interval 0.100, multiplier 3
Remote min TX interval 3.000, min RX interval 3.000, multiplier 3
Local discriminator 17, remote discriminator 67
Echo mode disabled/inactive, no-absorb, no-refresh
Remote is control-plane independent
Session ID: 0x0
```

Address	State	Interface	Detect Time	Transmit Interval	Multiplier
201:DB8:251::bb:bb:1 3		UP	xe-4/1/0	9.000	3.000

Client LACPD, TX interval 0.100, RX interval 0.100  
 Session up time 4d 23:13  
 Local diagnostic None, remote diagnostic None  
 Remote not heard, hears us, version 1  
 Replicated  
 Session type: **Micro BFD**  
 Min async interval 0.100, min slow interval 1.000  
 Adaptive async TX interval 0.100, RX interval 0.100  
 Local min TX interval 1.000, minimum RX interval 0.100, multiplier 3  
 Remote min TX interval 3.000, min RX interval 3.000, multiplier 3  
 Local discriminator 16, remote discriminator 66  
 Echo mode disabled/inactive, no-absorb, no-refresh  
 Remote is control-plane independent  
 Session ID: 0x0

4 sessions, 4 clients  
 Cumulative transmit rate 2.0 pps, cumulative receive rate 1.7 pps

**Meaning** The Micro BFD field represents the independent micro BFD sessions running on the links in a LAG. The TX interval [item], RX interval [item] output represents the setting configured with the **minimum-interval** statement. All of the other output represents the default settings for BFD. To modify the default settings, include the optional statements under **bfd-liveness-detection** statement.

### Viewing Detailed BFD Events

**Purpose** View the contents of the BFD trace file to assist in troubleshooting, if required.

**Action** From operational mode, enter the **file show /var/log/bfd** command.

```

user@R0> file show /var/log/bfd
Jun  5 00:48:59 Protocol (1) len 1: BFD
Jun  5 00:48:59 Data (9) len 41: (hex) 42 46 44 20 6e 65 69 67 68 62 6f 72 20
31 30 2e 30 2e 30
Jun  5 00:48:59 PPM Trace: BFD neighbor 10.255.106.102 (IFL 349) set, 9 0
Jun  5 00:48:59 Received Downstream RcvPkt (19) len 108:
Jun  5 00:48:59 IfIndex (3) len 4: 329
Jun  5 00:48:59 Protocol (1) len 1: BFD
Jun  5 00:48:59 SrcAddr (5) len 8: 10.255.106.102
Jun  5 00:48:59 Data (9) len 24: (hex) 00 88 03 18 00 00 00 4b 00 00 00 15 00
2d c6 c0 00 2d c6
Jun  5 00:48:59 PktError (26) len 4: 0
Jun  5 00:48:59 RtblIdx (24) len 4: 0
Jun  5 00:48:59 MultiHop (64) len 1: (hex) 00
Jun  5 00:48:59 Unknown (168) len 1: (hex) 01
Jun  5 00:48:59 Unknown (171) len 2: (hex) 02 3d
Jun  5 00:48:59 Unknown (172) len 6: (hex) 80 71 1f c7 81 c0
Jun  5 00:48:59 Authenticated (121) len 1: (hex) 01
Jun  5 00:48:59 BFD packet from 10.0.0.2 (IFL 329), len 24
Jun  5 00:48:59 Ver 0, diag 0, mult 3, len 24
Jun  5 00:48:59 Flags: IHU Fate
Jun  5 00:48:59 My discr 0x0000004b, your discr 0x00000015
Jun  5 00:48:59 Tx ivl 3000000, rx ivl 3000000, echo rx ivl 0
Jun  5 00:48:59 [THROTTLE]bfd_rate_limit_can_accept_pkt: session 10.255.106.102

```

```
is up or already in program thread
Jun  5 00:48:59 Replicate: marked session (discr 21) for update
```

**Meaning** BFD messages are being written to the specified trace file.

- Related Documentation**
- *authentication*
  - [bfd-liveness-detection on page 899](#)
  - *detection-time*
  - *Configuring Independent Micro BFD Sessions for LAG*
  - [Understanding Independent Micro BFD Sessions for LAG on page 189](#)

---

## Configuring Multicast Statistics Collection on Aggregated Ethernet Interfaces

T Series and TX Matrix routers support multicast statistics collection on aggregated Ethernet interfaces in both ingress and egress directions. The multicast statistics functionality can be configured on a physical interface thus enabling multicast accounting for all the logical interfaces below the physical interface.

The multicast statistics information is displayed only when the interface is configured with the **multicast-statistics** statement, which is not enabled by default.

Multicast statistics collection requires at least one logical interface is configured with family inet or inet6; otherwise, the commit for **multicast-statistics** will fail.

The multicast in/out statistics can be obtained via interfaces statistics query through CLI and via MIB objects through SNMP query.

To configure multicast statistics:

1. Include the **multicast-statistics** statement at the **[edit interfaces interface-name]** hierarchy level.

An example of a multicast statistics configuration for an aggregated Ethernet interface follows:

```
[edit interfaces]
ae0 {
  multicast-statistics;
}
```

To display multicast statistics, use the **show interfaces *interface-name* statistics detail** command.

- Related Documentation**
- *multicast-statistics*
  - [Configuring Multicast Statistics Collection on Ethernet Interfaces on page 20](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Deleting an Aggregated Ethernet Interface

---

There are two approaches to deleting an aggregated Ethernet interface:

- You can delete an aggregated Ethernet interface from the interface configuration. The Junos OS removes the configuration statements related to **aex** and sets this interface to down state.
- You can also permanently remove the aggregated Ethernet interface from the device configuration by deleting it from the device-count on the routing device.

To delete an aggregated Ethernet interface:

1. Delete the aggregated Ethernet configuration.

This step changes the interface state to down and removing the configuration statements related to **aex**.

```
[edit]  
user@host# delete interfaces aex
```

2. Delete the interface from the device count.

```
[edit]  
user@host# delete chassis aggregated-devices ethernet device-count
```

### Related Documentation

- [Configuring an Aggregated Ethernet Interface on page 126](#)
- [Configuring the Number of Aggregated Ethernet Interfaces on the Device on page 143](#)
- [Aggregated Ethernet Interfaces Overview on page 122](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Distributed Periodic Packet Management

---

Periodic packet management (PPM) is responsible for processing a variety of time-sensitive periodic tasks so that other processes can more optimally direct their resources.

The responsibility for PPM processing on the switch is distributed between the Routing Engine and the access interfaces for all protocols that use PPM by default. This distributed model provides a faster response time for protocols that use PPM than the response time provided by the nondistributed model.

If distributed PPM is disabled, the PPM process runs on the Routing Engine only.

You can disable distributed PPM for all protocols that use PPM. You can also disable distributed PPM for Link Aggregation Control Protocol (LACP) packets only.



**BEST PRACTICE:** We generally recommend that you disable distributed PPM only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM only if you have a compelling reason to disable it.

This topic describes:

- [Disabling or Enabling Distributed Periodic Packet Management Globally on page 203](#)
- [Disabling or Enabling Distributed Periodic Packet Management for LACP Packets on page 203](#)

## Disabling or Enabling Distributed Periodic Packet Management Globally

Distributed PPM is enabled by default. Disable distributed PPM if you need to move all PPM processing to the Routing Engine. Enable distributed PPM if it was previously disabled and you need to run distributed PPM.

To disable distributed PPM:

```
[edit routing-options]
user@switch# set ppm no-delegate-processing
```

To enable distributed PPM if it was previously disabled:

```
[edit routing-options]
user@switch# delete ppm no-delegate-processing
```

## Disabling or Enabling Distributed Periodic Packet Management for LACP Packets

Distributed PPM is enabled by default. Disable distributed PPM for only LACP packets if you need to move all PPM processing for LACP packets to the Routing Engine.

To disable distributed PPM for LACP packets:

```
[edit protocols]
user@switch# set lacp ppm centralized
```

To enable distributed PPM for LACP packets if it was previously disabled:

```
[edit protocols]
user@switch# delete lacp ppm centralized
```

### Related Documentation

- [Understanding Distributed Periodic Packet Management](#)
- [Understanding Aggregated Ethernet Interfaces and LACP](#)





## CHAPTER 9

# Configuring Ethernet Automatic Protection Switching for High Availability

- [Ethernet Automatic Protection Switching Overview on page 205](#)
- [Mapping of CCM Defects to APS Events on page 208](#)
- [Example: Configuring Protection Switching Between Psuedowires on page 209](#)

### Ethernet Automatic Protection Switching Overview

---

Ethernet automatic protection switching (APS) is a linear protection scheme designed to protect VLAN based Ethernet networks.

With Ethernet APS, a protected domain is configured with two paths, a working path and a protection path. Both working and protection paths can be monitored using an Operations Administration Management (OAM) protocol like Connectivity Fault Management (CFM). Normally, traffic is carried on the working path (that is, the working path is the active path), and the protection path is disabled. If the working path fails, its protection status is marked as degraded (DG) and APS switches the traffic to the protection path, then the protection path becomes the active path.

APS uses two modes of operation, linear 1+1 protection switching architecture and linear 1:1 protection switching architecture. The linear 1+1 protection switching architecture operates with either unidirectional or bidirectional switching. The linear 1:1 protection switching architecture operates with bidirectional switching.

In the linear 1+1 protection switching architecture, the normal traffic is copied and fed to both working and protection paths with a permanent bridge at the source of the protected domain. The traffic on the working and protection transport entities is transmitted simultaneously to the sink of the protected domain, where a selection between the working and protection transport entities is made.

In the linear 1:1 protection switching architecture, the normal traffic is transported on either the working path or on the protection path using a selector bridge at the source of the protection domain. The selector at the sink of the protected domain selects the entity that carries the normal traffic.

## Unidirectional and Bidirectional Switching

Unidirectional switching utilizes fully independent selectors at each end of the protected domain. Bidirectional switching attempts to configure the two end points with the same bridge and selector settings, even for a unidirectional failure. Unidirectional switching can protect two unidirectional failures in opposite directions on different entities.

## Selective and Merging Selectors

In the linear 1:1 protection switching architecture, where traffic is sent only on the active path, there are two different ways in which the egress direction (the direction out of the protected segment) data forwarding can act: selective selectors and merging selectors. A selective selector forwards only traffic that is received from both the paths regardless of which one is currently active. In other words, with a merging selector the selection of the currently active path only affects the ingress direction. Merging selectors minimize the traffic loss during a protection switch, but they do not guarantee the delivery of the data packets in order.

## Revertive and Nonrevertive Switching

For revertive switching, traffic is restored to the working path after the conditions causing the switch have cleared.

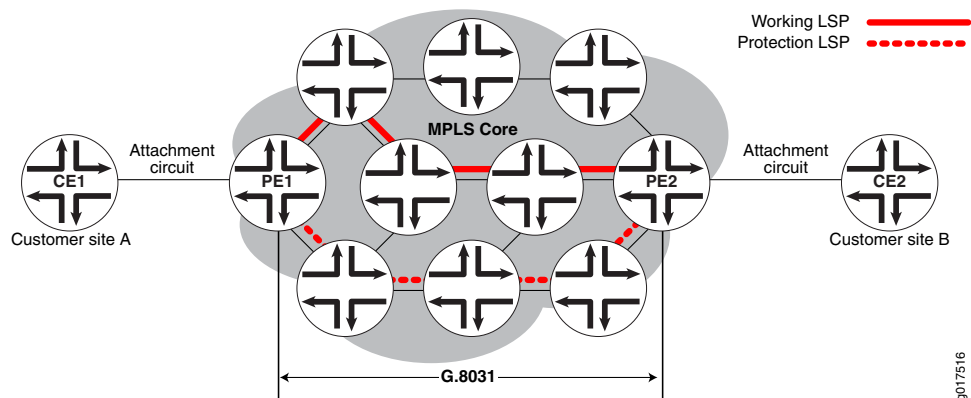
For nonrevertive switching, traffic is allowed to remain on the protection path even after the conditions causing the switch have cleared.



**NOTE:** The configuration on both the provider edge (PE) routers have to be either in revertive mode or non-revertive mode.

## Protection Switching Between VPWS Pseudowires

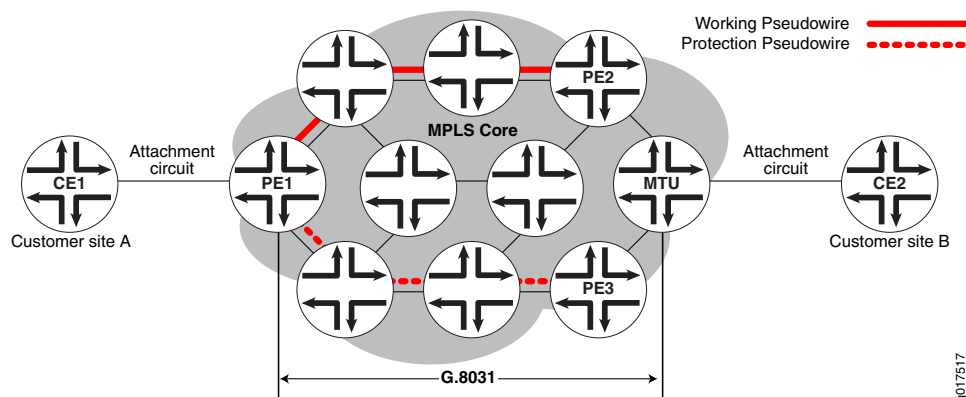
Figure 11: Connections Terminating on Single PE



In the scenario diagrammed in Figure 11 on page 206, a Virtual Private Wire Service (VPWS) is provisioned between customer sites A and B using a single pseudowire (layer 2 circuit) in the core network, and two Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) are provisioned, one for the working path and the other one for the protection

path. CFM CCM will be used to monitor the status of each LSP. Provider edge routers PE1 and PE2 run G.8031 Ethernet APS to select one of the LSPs as the active path. Once the active path is elected at the source end of the protection group, PE1 forwards traffic from site A to the elected active path. At the sink end of the protection group, PE2 implements a merging selector, meaning it forwards the traffic coming from both the LSPs to the customer site B.

Figure 12: Connections Terminating on a Different PE



In the scenario represented in Figure 12 on page 207, a VPWS is provisioned between customer sites A and B using two pseudowires (layer 2 circuit) in the core network, one for the working path and the other for the protection path. CFM CCM will be used to monitor the status of each pseudowire.

Provider edge router PE1 and MTU run G.8031 Ethernet APS to select one of the pseudowires as the active path. Once the active path is elected at the source end of the protection group, PE1 forwards the traffic from site A to the elected active path. At the sink end of the protection group, MTU implements a merging selector, meaning it forwards the traffic coming from both the pseudowires to customer site B.

## CLI Configuration Statements

```
[edit protocols protection-group]
ethernet-aps profile1{
  protocol g8031;
  revert-time seconds;
  hold-time 0-10000ms;
  local-request lockout;
}
```

**revert-time-** By default, protection logic restores the use of the working path once it recovers. The revert-time statement specifies how much time should elapse before the path for data should be switched from Protection to Working once recovery for Working has occurred. A revert-time of zero indicates no reversion. It will default to 300 sec (5 minutes) if not configured.

**hold-time-** Once a failure is detected, APS waits until this timer expires before initiating the protection switch. The range of the hold-time timer is 0 to 10,000 milliseconds. It will default to zero if not configured.

**local-request-** Configuring this value to lockout or force-switch will trigger lockout or force-switch operation on the protection groups using this profile.

- Related Documentation**
- [Mapping of CCM Defects to APS Events on page 208](#)
  - [Example: Configuring Protection Switching Between Psuedowires on page 209](#)

## Mapping of CCM Defects to APS Events

The continuity check message (CCM) engine marks the status of working and protected transport entities as either Down, Degraded, or Up.

**Down**—The monitored path is declared down if any of the following Multiple End Point (MEP) defects occur:

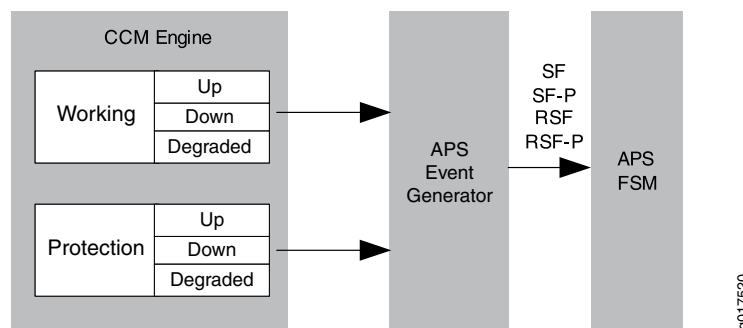
- Interface down
- CCM expiry
- RDI indicating signal failure

**Degraded**—The monitored path is declared degraded if any of the following MEP defects occur:

- FRR on
- FRR-ACK on

**Up**—The monitored path is declared up in the absence of any of the above events.

**Figure 13: Understanding APS Events**



As show in [Figure 13 on page 208](#), the APS event generator generates the following APS events based on the status of the working and protection paths:

- **SF**—Signal failure on working path
- **RSF**—Working path recovers from signal failure
- **SF-P**—Signal failure on protection path
- **RSF-P**—Protection path recovers from signal failure

- Related Documentation**
- [Ethernet Automatic Protection Switching Overview on page 205](#)
  - [Example: Configuring Protection Switching Between Psuedowires on page 209](#)

## Example: Configuring Protection Switching Between Psuedowires

- [Requirements on page 209](#)
- [Overview and Topology on page 209](#)
- [Configuration on page 209](#)

### Requirements

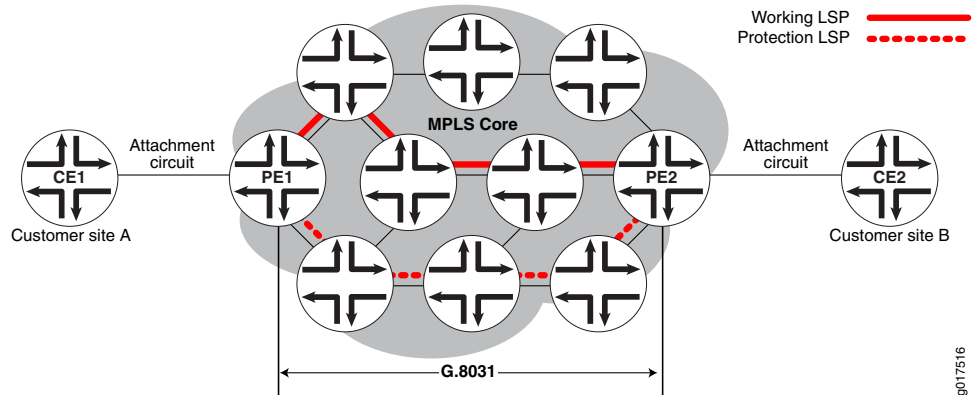
This example uses the following hardware and software components:

- Junos OS Release 11.2 or later
- 2 MX Series PE routers

### Overview and Topology

The physical topology of the protection switching between psuedowires example is shown in [Figure 14 on page 209](#).

**Figure 14: Topology of a Network Using VPWS Psuedowires**



The following definitions describe the meaning of the device abbreviations used in [Figure 14 on page 209](#).

- Customer edge (CE) device—A device at the customer site that provides access to the service provider's VPN over a data link to one or more provider edge (PE) routers.
- Provider edge (PE) device—A device, or set of devices, at the edge of the provider network that presents the provider's view of the customer site.

### Configuration

- Step-by-Step Procedure**
- To configure protection switching between psuedowires, perform these tasks:
1. Configure automatic protection switching.

```
protocols {
  protection-group {
    ethernet-aps {
      profile-1 {
        protocol g8031;
        hold-time 1000s;
        revert-time 5m;
      }
    }
  }
}
```

2. Configure the connectivity fault management.

```
ethernet {
  oam {
    connectivity-fault-management {
      maintenance-domain md1 {
        level 5;
      }
    }
  }
}
```

3. Configure the continuity check message for the working path.

```
maintenance-association W {
  protect maintenance-association P {
    aps-profile profile-1;
  }
  continuity-check {
    interval 1s;
  }
  mep 100 {
    interface ge-1/0/0.0 working;
    direction down;
    auto-discovery;
  }
}
```

4. Configure the continuity check message for the protection path.

```
maintenance-association P {
  continuity-check {
    interval 1s;
  }
  mep 100 {
    interface ge-1/0/0.0 protect;
    direction down;
    auto-discovery;
  }
}
```

**Results** Check the results of the configuration:

```
protocols {
  protection-group {
    ethernet-aps {
      profile-1 {
        protocol g8031;
        hold-time 1000s;
        revert-time 5m;
      }
    }
  }
}
```

```

    }
  }
  ethernet {
    oam {
      connectivity-fault-management {
        maintenance-domain md1 {
          level 5;
          maintenance-association W {
            protect maintenance-association P {
              aps-profile profile-1;
            }
            continuity-check {
              interval 1s;
            }
            mep 100 {
              interface ge-1/0/0.0 working;
              direction down;
              auto-discovery;
            }
          }
        }
        maintenance-association P {
          continuity-check {
            interval 1s;
          }
          mep 100 {
            interface ge-1/0/0.0 protect;
            direction down;
            auto-discovery;
          }
        }
      }
    }
  }
}

```

- Related Documentation**
- [Ethernet Automatic Protection Switching Overview on page 205](#)
  - [Mapping of CCM Defects to APS Events on page 208](#)





## CHAPTER 10

# Configuring Ethernet Ring Protection Switching for High Availability

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Understanding Ethernet Ring Protection Switching Functionality on page 214](#)
- [Configuring Ethernet Ring Protection Switching on page 220](#)
- [Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 221](#)

## Ethernet Ring Protection Switching Overview

---

*Ethernet ring protection switching* (ERPS) helps achieve high reliability and network stability. Links in the ring will never form loops that fatally affect the network operation and services availability. The basic idea of an Ethernet ring is to use one specific link to protect the whole ring. This special link is called a *ring protection link (RPL)*. If no failure happens in other links of the ring, the RPL blocks the traffic and is not used. The RPL is controlled by a special node called an *RPL owner*. There is only one RPL owner in a ring. The RPL owner is responsible for blocking traffic over the RPL. Under ring failure conditions, the RPL owner is responsible for unblocking traffic over the RPL. A ring failure results in protection switching of the RPL traffic. An automatic protection switching (APS) protocol is used to coordinate the protection actions over the ring. Protection switching blocks traffic on the failed link and unblocks the traffic on the RPL. When the failure clears, revertive protection switching blocks traffic over the RPL and unblocks traffic on the link on which the failure is cleared.

The following standards provide detailed information on Ethernet ring protection switching:

- IEEE 802.1Q - 1998
- IEEE 802.1D - 2004
- IEEE 802.1Q - 2003
- Draft ITU-T Recommendation G.8032/Y.1344, *Ethernet Ring protection switching*
- ITU-T Y.1731, *OAM functions and mechanisms for Ethernet-based networks*

For additional information on configuring Ethernet ring protection switching on EX Series switches, see *Example: Configuring Ethernet Ring Protection Switching on EX Series Switches*.

For additional information on configuring Ethernet ring protection switching on MX Series routers, see the *Layer 2 Configuration Guide* for a complete example of Ethernet rings and information about STP loop avoidance and prevention.

**Related  
Documentation**

- [Understanding Ethernet Ring Protection Switching Functionality on page 214](#)
- [Configuring Ethernet Ring Protection Switching on page 220](#)
- [Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 221](#)
- [Example: Configuring Ethernet Ring Protection Switching on EX Series Switches](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Understanding Ethernet Ring Protection Switching Functionality

- [Acronyms on page 214](#)
- [Ring Nodes on page 215](#)
- [Ring Node States on page 215](#)
- [Default Logging of Basic State Transitions on EX Series Switches on page 215](#)
- [Failure Detection on page 216](#)
- [Logical Ring on page 216](#)
- [FDB Flush on page 216](#)
- [Traffic Blocking and Forwarding on page 216](#)
- [RPL Neighbor Node on page 217](#)
- [RAPS Message Blocking and Forwarding on page 217](#)
- [Dedicated Signaling Control Channel on page 218](#)
- [RAPS Message Termination on page 218](#)
- [Revertive and Non-revertive Modes on page 219](#)
- [Multiple Rings on page 219](#)
- [Node ID on page 219](#)
- [Ring ID on page 219](#)
- [Bridge Domains with the Ring Port \(MX Series Routers Only\) on page 219](#)
- [Wait-to-Block Timer on page 219](#)
- [Adding and Removing a Node on page 220](#)

## Acronyms

The following acronyms are used in the discussion about Ethernet ring protection switching (ERPS):

- MA—Maintenance association
- MEP—Maintenance association end point
- OAM—Operations, administration, and management (Ethernet ring protection switching uses connectivity fault management daemon)

- FDB—MAC forwarding database
- STP—Spanning Tree Protocol
- RAPS—Ring automatic protection switching
- WTB—Wait to block
- WTR—Wait to restore
- RPL—Ring protection link

## Ring Nodes

Multiple nodes are used to form a ring. There are two different node types:

- Normal node—The node has no special role on the ring.
- RPL owner node—The node owns the RPL and blocks or unblocks traffic over the RPL.

## Ring Node States

The following are the different states for each node of a specific ring:

- init—Not a participant of a specific ring.
- idle—No failure on the ring; the node is performing normally. For a normal node, traffic is unblocked on both ring ports. For the RPL owner or RPL neighbor, traffic is blocked on the ring port that connects to the RPL and unblocked on the other ring port.
- protection—A failure occurred on the ring. For a normal node, traffic is blocked on the ring port that connects to the failing link and unblocked on working ring ports. For the RPL owner, traffic is unblocked on both ring ports if they connect to non-failure links.
- pending—The node is recovering from failure or its state after a **clear** command is used to remove the previous manual command. When a protection group is configured, the node enters the pending state. When a node is in pending state, the WTR or WTB timer will be running. All nodes are in pending state till WTR or WTB timer expiry.
- force switch—A force switch is issued. When a force switch is issued on a node in the ring all nodes in the ring will move into the force switch state.
- manual switch—A manual switch is issued. When a manual switch is issued on a node in the ring all nodes in the ring will move into the manual switch state.

There can be only one RPL owner for each ring. The user configuration must guarantee this, because the APS protocol cannot check this.

## Default Logging of Basic State Transitions on EX Series Switches



**NOTE:** This section applies only to EX Series switches that run Junos OS that does not support the Enhanced Layer 2 Software (ELS) configuration style.

EX Series switches automatically log basic state transitions for the ERPS protocol. No configuration is required to initiate this logging. Basic state transitions include ERPS

interface transitions from up to down, and down to up; and ERPS state transitions from idle to protection, and protection to idle.

The basic state transitions are logged in a single file named **erp-default**, which resides in the **/var/log** directory of the switch. The maximum size of this file is 15 MB.

Default logging for ERPS can capture initial ERPS interface and state transitions, which can help you troubleshoot issues that occur early in the ERPS protocol startup process. However, if more robust logging is needed, you can enable traceoptions for ERPS by entering the **traceoptions** statement in the **[edit protocols protection-group]** hierarchy.

Be aware that for ERPS, only default logging or traceoptions can be active at a time on the switch. That is, default logging for ERPS is automatically enabled and if you enable traceoptions for ERPS, the switch automatically disables default logging. Conversely, if you disable traceoptions for ERPS, the switch automatically enables default logging.

## Failure Detection

Ethernet ring operation depends on quick and accurate failure detection. The failure condition *signal failure (SF)* is supported. For SF detection, an Ethernet continuity check MEP must be configured for each ring link. For fast protection switching, a 10-ms transmission period for this MEP group is supported. OAM monitors the MEP group's MA and reports SF or SF clear events to the Ethernet ring control module. For this MEP group, the action profile must be configured to update the interface device IFF\_LINKDOWN flag. OAM updates the IFF\_LINKDOWN flag to notify the Ethernet ring control module.

## Logical Ring

You can define multiple logical-ring instances on the same physical ring. The logical ring feature currently supports only the physical ring, which means that two adjacent nodes of a ring must be physically connected and the ring must operate on the physical interface, not the VLAN. Multiple ring instances are usually defined with trunk mode ring interfaces.

## FDB Flush

When ring protection switching occurs, normally an *FDB flush* is executed. The Ethernet ring control module uses the same mechanism as the STP to trigger the FDB flush. The Ethernet ring control module controls the ring port physical interface's default STP index to execute the FDB flush.

Starting with Junos OS Release 14.2, the FDB flush depends on the RAPS messages received on the both the ports of the ring node.

## Traffic Blocking and Forwarding

Ethernet ring control uses the same mechanism as the STP to control forwarding or discarding of user traffic. The Ethernet ring control module sets the ring port physical interface default STP index state to forwarding or discarding in order to control user traffic.

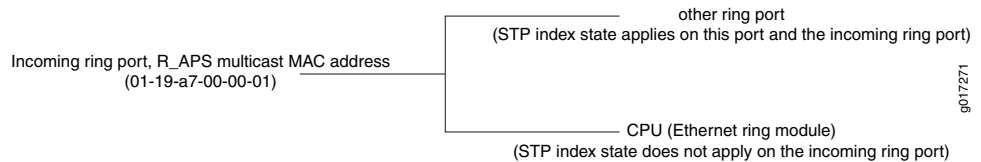
## RPL Neighbor Node

Starting with Junos OS Release 14.2, ring protection link neighbor nodes are supported. An RPL neighbor node is adjacent to the RPL and is not the RPL owner. If a node is configured with one interface as the protection-link-end and no protection-link-owner is present in its configuration, the node is an RPL neighbor node.

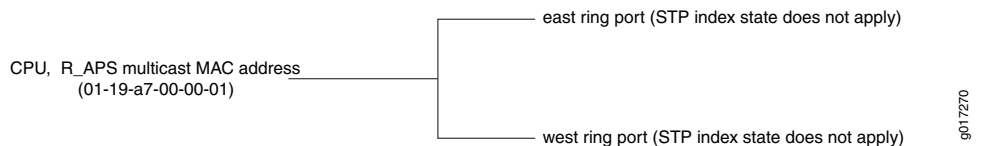
## RAPS Message Blocking and Forwarding

The router or switch treats the ring automatic protection switching (RAPS) message the same as it treats user traffic for forwarding RAPS messages between two ring ports. The ring port physical interface default STP index state also controls forwarding RAPS messages between the two ring ports. Other than forwarding RAPS messages between the two ring ports, as shown in [Figure 15 on page 217](#), the system also needs to forward the RAPS message between the CPU (Ethernet ring control module) and the ring port. This type of forwarding does not depend on the ring port physical interfaces' STP index state. The RAPS message is always sent by the router or switch through the ring ports, as shown in [Figure 16 on page 217](#). A RAPS message received from a discarding ring port is sent to the Ethernet ring control module, but is not sent to the other ring port.

**Figure 15: Protocol Packets from the Network to the Router**



**Figure 16: Protocol Packets from the Router or Switch to the Network**



Juniper Networks switches and Juniper Networks routers use different methods to achieve these routes.

The switches use forwarding database entries to direct the RAPS messages. The forwarding database entry (keyed by the RAPS multicast address and VLAN) has a composite next hop associated with it—the composite next hop associates the two ring interfaces with the forwarding database entry and uses the split horizon feature to prevent sending the packet out on the interface that it is received on. This is an example of the forwarding database entry relating to the RAPS multicast MAC (a result of the **show ethernet-switching table detail** command):

```

VLAN: v1, Tag: 101, MAC: 01:19:a7:00:00:01, Interface: ERP
Interfaces:      ge-0/0/9.0, ge-0/0/3.0
Type: Static
Action: Mirror
Nexthop index: 1333
  
```

The routers use an implicit filter to achieve ERP routes. Each implicit filter binds to a bridge domain. Therefore, the east ring port control channel and the west ring port control channel of a particular ring instance must be configured to the same bridge domain. For each ring port control channel, a filter term is generated to control RAPS message forwarding. The filter number is the same as the number of bridge domains that contain the ring control channels. If a bridge domain contains control channels from multiple rings, the filter related to this bridge domain will have multiple terms and each term will relate to a control channel. The filter has command parts and control-channel related parts, as follows:

- Common terms:
  - term 1: if [Ethernet type is not OAM Ethernet type (0x8902)]  
          { accept packet }
  - term 2: if [source MAC address belongs to this bridge]  
          { drop packet, our packet loop through the ring and come back to home }
  - term 3: if [destination is the RAPS PDU multicast address(0x01,0x19,0xa7,0x00,0x00,0x01) AND[ring port STP status is DISCARDING]  
          { send to CPU }
- Control channel related terms:
  - if [destination is the RAPS PDU multicast address(0x01,0x19,0xa7,0x00,0x00,0x01) AND[ring port STP status is FORWARDING] AND [Incoming interface IFL equal to control channel IFL]  
      { send packet to CPU and send to the other ring port }  
      default term: accept packet.

## Dedicated Signaling Control Channel

For each ring port, a dedicated signaling control channel with a dedicated VLAN ID must be configured. In Ethernet ring configuration, only this control logical interface is configured and the underlying physical interface is the physical ring port. Each ring requires that two control physical interfaces be configured. These two logical interfaces must be configured in a bridge domain for routers (or the same VLAN for switches) in order to forward RAPS protocol data units (PDUs) between the two ring control physical interfaces. If the router control channel logical interface is not a trunk port, only control logical interfaces will be configured in ring port configuration. If this router control channel logical interface is a trunk port, in addition to the control channel logical interfaces, a dedicated VLAN ID must be configured for routers. For switches, always specify either a VLAN name or VLAN ID for all links.

## RAPS Message Termination

The RAPS message starts from the originating node, travels through the entire ring, and terminates in the originating node unless a failure is present in the ring. The originating node must drop the RAPS message if the source MAC address in the RAPS message belongs to itself. The source MAC address is the node's node ID.

## Revertive and Non-revertive Modes

In revertive operation, once the condition causing a switch has cleared, traffic is blocked on the RPL and restored to the working transport entity. In nonrevertive operation, traffic is allowed to use the RPL if it has not failed, even after a switch condition has cleared.

## Multiple Rings

The Ethernet ring control module supports multiple rings in each node (two logical interfaces are part of each ring). The ring control module also supports the interconnection of multiple rings. Interconnection of two rings means that two rings might share the same link or share the same node. Ring interconnection is supported only using non-virtual-channel mode. Ring interconnection using virtual channel mode is not supported.

## Node ID

For each node in the ring, a unique *node ID* identifies each node. The node ID is the node's MAC address.

For routers only, you can configure this node ID when configuring the ring on the node or automatically select an ID like STP does. In most cases, you will not configure this and the router will select a node ID, like STP does. It should be the manufacturing MAC address. The ring node ID should not be changed, even if you change the manufacturing MAC address. Any MAC address can be used if you make sure each node in the ring has a different node ID. The node ID on switches is selected automatically and is not configurable.

## Ring ID

The ring ID is used to determine the value of the last octet of the MAC destination address field of the RAPS protocol data units (PDUs) generated by the ERP control process. The ring ID is also used to discard any RAPS PDU, received by this ERP control process with a non-matching ring ID. Ring ID values 1 through 239 are supported.

## Bridge Domains with the Ring Port (MX Series Routers Only)

On the routers, the protection group is seen as an abstract logical port that can be configured to any bridge domain. Therefore, if you configure one ring port or its logical interface in a bridge domain, you must configure the other related ring port or its logical interface to the same bridge domain. The bridge domain that includes the ring port acts as any other bridge domain and supports the IRB Layer 3 interface.

## Wait-to-Block Timer

The RPL owner node uses a delay timer before initiating an RPL block in revertive mode of operation or before reverting to IDLE state after clearing manual commands. The Wait-to-Block (WTB) timer is used when clearing **force switch** and **manual switch** commands. As multiple **force switch** commands are allowed to coexist in an Ethernet ring, the WTB timer ensures that clearing of a single **force switch** command does not trigger the re-blocking of the RPL. When clearing a **manual switch** command, the WTB timer prevents the formation of a closed loop due to a possible timing anomaly where

the RPL Owner Node receives an outdated remote **manual switch** request during the recovery process.

When recovering from a **manual switch** command, the delay timer must be long enough to receive any latent remote **force switch**, signal failure, or **manual switch** commands. This delay timer is called the WTB timer and is defined to be 5 seconds longer than the guard timer. This delay timer is activated on the RPL Owner Node. When the WTB timer expires, the RPL Owner Node initiates the reversion process by transmitting an RAPS (NR, RB) message. The WTB timer is deactivated when any higher-priority request preempts it.

## Adding and Removing a Node

Starting with Junos OS Release 14.2, you can add or remove a node between two nodes in an Ethernet ring. Nodes are added or removed using the **force switch** command.

### Related Documentation

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Configuring Ethernet Ring Protection Switching on page 220](#)
- [Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 221](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Example: Configuring Ethernet Ring Protection Switching on EX Series Switches*
- *Configuring Ethernet Ring Protection Switching (CLI Procedure)*

## Configuring Ethernet Ring Protection Switching

---

The inheritance model follows:

```
protection-group {
  ethernet-ring ring-name (
    node-id mac-address;
    ring-protection-link-owner;
    east-interface {
      control-channel channel-name {
        ring-protection-link-end;
      }
    }
    west-interface {
      node-id mac-address;
      control-channel channel-name {
        ring-protection-link-end;
      }
    }
    data-channel {
      vlan number;
    }
    guard-interval number;
    restore-interval number;
  }
}
```



For each ring, a protection group must be configured. There may be several rings in each node, so there should be multiple protection groups corresponding to the related Ethernet rings.

Three interval parameters (**restore-interval**, **guard-interval**, and **hold-interval**) can be configured at the protection group level. These configurations are global configurations and apply to all Ethernet rings if the Ethernet ring doesn't have a more specific configuration for these values. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value.

**Related  
Documentation**

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Understanding Ethernet Ring Protection Switching Functionality on page 214](#)
- [Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 221](#)
- [Example: Configuring Ethernet Ring Protection Switching on EX Series Switches](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Example: Ethernet Ring Protection Switching Configuration on MX Routers

This example describes how to configure Ethernet ring protection switching on an MX Series router:

- [Requirements on page 221](#)
- [Ethernet Ring Overview and Topology on page 221](#)
- [Configuring a Three-Node Ring on page 222](#)

### Requirements

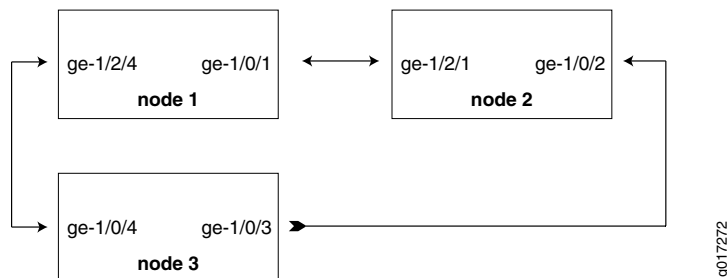
This example uses the following hardware and software components:

- Router node 1 running Junos OS with two Gigabit Ethernet interfaces.
- Router node 2 running Junos OS with two Gigabit Ethernet interfaces.
- Router node 3 running Junos OS with two Gigabit Ethernet interfaces.

### Ethernet Ring Overview and Topology

This section describes a configuration example for a three-node ring. The ring topology is shown in [Figure 17 on page 222](#).

Figure 17: Example of a Three-Node Ring Topology



The configuration in this section is only for the RAPS channel. The bridge domain for user traffic is the same as the normal bridge domain. The only exception is if a bridge domain includes a ring port, then it must also include the other ring port of the same ring.

## Configuring a Three-Node Ring

To configure Ethernet Ring Protection Switching on a three-node ring, perform these tasks:

- [Configuring Ethernet Ring Protection Switching on a Three-Node Ring on page 222](#)

### Configuring Ethernet Ring Protection Switching on a Three-Node Ring

#### Step-by-Step Procedure

##### 1. Configuring Node 1

```

interfaces {
  ge-1/0/1 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
  ge-1/2/4 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
}
bridge-domains {
  bd1 {
    domain-type bridge;
    interface ge-1/2/4.1;
    interface ge-1/0/1.1;
  }
}
protocols {
  protection-group {
    ethernet-ring pg101 {
      node-id 00:01:01:00:00:01;
    }
  }
}
  
```

```

ring-protection-link-owner;
east-interface {
    control-channel ge-1/0/1.1;
    ring-protection-link-end;
}
west-interface {
    control-channel ge-1/2/4.1;
}
}
}
}
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                action-profile rmep-defaults {
                    default-action {
                        interface-down;
                    }
                }
            }
            maintenance-domain d1 {
                level 0;
                maintenance-association 100 {
                    mep 1 {
                        interface ge-1/0/1;
                    }
                    remote-mep 2 {
                        action-profile rmep-defaults;
                    }
                }
            }
            maintenance-domain d2 {
                level 0;
                maintenance-association 100 {
                    mep 1 {
                        interface ge-1/2/4;
                    }
                    remote-mep 2 {
                        action-profile rmep-defaults;
                    }
                }
            }
        }
    }
}
}
}
}
}
}
}
}
}
}

```

## 2. Configuring Node 2

```

interfaces {
    ge-1/0/2 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
}

```

```
    }
  }

  ge-1/2/1 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
}

bridge-domains {
  bd1 {
    domain-type bridge;
    interface ge-1/2/1.1;
    interface ge-1/0/2.1;
  }
}

protocols {
  protection-group {
    ethernet-ring pg102 {
      east-interface {
        control-channel ge-1/0/2.1;
      }
      west-interface {
        control-channel ge-1/2/1.1;
      }
    }
  }
}

protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        action-profile rmep-defaults {
          default-action {
            interface-down;
          }
        }
      }
      maintenance-domain d1 {
        level 0;
        maintenance-association 100 {
          mep 2 {
            interface ge-1/2/1;
            remote-mep 1 {
              action-profile rmep-defaults;
            }
          }
        }
      }
    }
  }
}
```

```

maintenance-domain d3 {
  level 0;
  maintenance-association 100 {
    mep 1 {
      interface ge-1/0/2;
      remote-mep 2 {
        action-profile rmep-defaults;
      }
    }
  }
}

```

### 3. Configuring Node 3

```

interfaces {
  ge-1/0/4 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }

  ge-1/0/3 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
}

bridge-domains {
  bd1 {
    domain-type bridge;
    interface ge-1/0/4.1;
    interface ge-1/0/3.1;
  }
}

protocols {
  protection-group {
    ethernet-ring pg103 {
      east-interface {
        control-channel ge-1/0/3.1;
      }
      west-interface {
        control-channel ge-1/0/4.1;
      }
    }
  }
}

```

```

    }
  }

  protocols {
    oam {
      ethernet {
        connectivity-fault-management {
          action-profile rmep-defaults {
            default-action {
              interface-down;
            }
          }
        }
        maintenance-domain d2 {
          level 0;
          maintenance-association 100 {
            mep 2 {
              interface ge-1/0/4;
              remote-mep 1 {
                action-profile rmep-defaults;
              }
            }
          }
        }
        maintenance-domain d3 {
          level 0;
          maintenance-association 100 {
            mep 2 {
              interface ge-1/0/3;
              remote-mep 1 {
                action-profile rmep-defaults;
              }
            }
          }
        }
      }
    }
  }
}

```

#### Examples: Ethernet RPS Output

This section provides output examples based on the configuration shown in [“Example: Ethernet Ring Protection Switching Configuration on MX Routers” on page 221](#). The show commands used in these examples can help verify configuration and correct operation.

#### Normal Situation—RPL Owner Node

If the ring has no failure, the **show** command will have the following output for Node 1:

```
user@node1> show protection-group ethernet-ring aps
```

Ethernet Ring Name	Request/state	No Flush	Ring Protection Link Blocked
pg101	NR	No	Yes

```
Originator Remote Node ID
Yes
```

```
user@node1> show protection-group ethernet-ring interface
```

Ethernet ring port parameters for protection group pg101

Interface	Control Channel	Forward State	Ring Protection Link End
ge-1/0/1	ge-1/0/1.1	discarding	Yes
ge-1/2/4	ge-1/2/4.1	forwarding	No

Signal Failure Admin State

Clear IFF ready

Clear IFF ready

user@node1> show protection-group ethernet-ring node-state

Ethernet ring	APS State	Event	Ring Protection Link Owner
pg101	idle	NR-RB	Yes

Restore Timer Quard Timer Operation state

disabled disabled operational

user@node1> show protection-group ethernet-ring statistics group-name pg101

Ethernet Ring statistics for PG pg101

RAPS sent : 1

RAPS received : 0

Local SF happened: : 0

Remote SF happened: : 0

NR event happened: : 0

NR-RB event happened: : 1

## Normal Situation—Other Nodes

For Node 2 and Node 3, the outputs should be the same:

user@node2> show protection-group ethernet-ring aps

Ethernet Ring Name	Request/state	No Flush	Ring Protection Link Blocked
pg102	NR	No	Yes

Originator Remote Node ID

No 00:01:01:00:00:01

user@node2> show protection-group ethernet-ring interface

Ethernet ring port parameters for protection group pg102

Interface	Control Channel	Forward State	Ring Protection Link End
ge-1/2/1	ge-1/2/1.1	forwarding	No
ge-1/0/2	ge-1/0/2.1	forwarding	No

Signal Failure Admin State

Clear IFF ready

Clear IFF ready

user@node2> show protection-group ethernet-ring node-state

Ethernet ring	APS State	Event	Ring Protection Link Owner
pg102	idle	NR-RB	No

Restore Timer Quard Timer Operation state

disabled disabled operational

user@node2> show protection-group ethernet-ring statistics group-name pg102

Ethernet Ring statistics for PG pg101

RAPS sent : 0

RAPS received : 1

Local SF happened: : 0

Remote SF happened: : 0

NR event happened: : 0

NR-RB event happened: : 1

### Failure Situation—RPL Owner Node

If the ring has a link failure between Node 2 and Node 3, the **show** command will have the following outputs for Node 1:

```

user@node1> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg101              SF           NO      No

Originator Remote Node ID
No          00:01:02:00:00:01

user@node1> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface Control Channel Forward State Ring Protection Link End
ge-1/0/1   ge-1/0/1.1         forwarding Yes
ge-1/2/4   ge-1/2/4.1         forwarding No

Signal Failure Admin State
Clear        IFF ready
Clear        IFF ready

user@node1> show protection-group ethernet-ring node-state
Ethernet ring APS State Event Ring Protection Link Owner
pg101         protected SF      Yes

Restore Timer Guard Timer Operation state
disabled      disabled operational

user@node1> show protection-group ethernet-ring statistics group-name pg101
Ethernet Ring statistics for PG pg101
RAPS sent : 1
RAPS received : 1
Local SF happened: 0
Remote SF happened: 1
NR event happened: 0
NR-RB event happened: 1

```

### Failure Situation—Other Nodes

For Node 2 and Node 3, the outputs should be the same:

```

user@node2> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg102              SF           No      No

Originator Remote Node ID
Yes         00:00:00:00:00:00

user@node2> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg102

Interface Control Channel Forward State Ring Protection Link End
ge-1/2/1   ge-1/2/1.1         forwarding No
ge-1/0/2   ge-1/0/2.1         discarding No

Signal Failure Admin State
Clear        IFF ready
set          IFF ready

user@node2> show protection-group ethernet-ring node-state

```



```

Ethernet ring    APS State    Event    Ring Protection Link Owner
pg102           idle        NR-RB    No

```

```

Restore Timer    Quard Timer    Operation state
disabled         disabled       operational

```

```

user@node2> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg101
RAPS sent                : 1
RAPS received            : 1
Local SF happened:        : 1
Remote SF happened:       : 0
NR event happened:        : 0
NR-RB event happened:     : 1

```

#### Related Documentation

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Understanding Ethernet Ring Protection Switching Functionality on page 214](#)
- [Configuring Ethernet Ring Protection Switching on page 220](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*



# Configuring MAC Address Validation on Static Ethernet Interfaces

- [MAC Address Validation on Static Ethernet Interfaces Overview on page 231](#)
- [Configuring MAC Address Validation on Static Ethernet Interfaces on page 232](#)
- [Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors on page 232](#)

## MAC Address Validation on Static Ethernet Interfaces Overview

---

MAC address validation enables the router to validate that received packets contain a trusted IP source and an Ethernet MAC source address.

MAC address validation is supported on AE, Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces (with or without VLAN tagging) on MX Series routers only.

There are two types of MAC address validation that you can configure:

- **Loose**—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

Drops packets when the IP source address matches one of the trusted tuples, but the MAC address does not support the MAC address of the tuple

Continues to forward packets when the source address of the incoming packet does not match any of the trusted IP addresses.

- **Strict**—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

Drops packets when the MAC address does not match the tuple's MAC source address, or when IP source address of the incoming packet does not match any of the trusted IP addresses.

### Related Documentation

- [Configuring MAC Address Validation on Static Ethernet Interfaces on page 232](#)
- [Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors on page 232](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring MAC Address Validation on Static Ethernet Interfaces

---

MAC address validation enables the router to validate that received packets contain a trusted IP source and an Ethernet MAC source address. MAC address validation is supported on AE, Fast Ethernet, Gigabit Ethernet, and 10–Gigabit Ethernet interfaces (with or without VLAN tagging) on MX Series routers only.

To configure MAC address validation on static Ethernet Interfaces:

1. In the configuration mode, at the **[edit]** hierarchy level, configure the static Ethernet interface.

```
[edit]
user@host# edit interfaces interface-name
```

2. Configure the protocol family and the logical unit of the interface at the **[edit interfaces *interface-name*]** hierarchy level. While configuring the protocol family, specify **inet** as the protocol family.

```
[edit interfaces interface-name]
user@host# edit unit logical-unit-number family inet
```

3. Configure MAC address validation on the static Ethernet Interface. You can specify the type of MAC address validation you require. Possible values are: Strict and Loose. You can also specify the interface address.

```
[edit interfaces interface-name] unit logical-unit-number family inet
user@host# set mac-validate option address address
```

4. Configure the static ARP entry by specifying the IP address and the MAC address that are to be mapped. The IP address specified must be part of the subnet defined in the enclosing **address** statement. The MAC address must be specified as hexadecimal bytes in the following formats: *nnnn.nnnn.nnnn* or *nn:nn:nn:nn:nn:nn* format. For instance, you can use either 0011.2233.4455 or 00:11:22:33:44:55.

```
[edit interfaces interface-name unit logical-unit-number family inet address
interface-address]
user@host# set arp ip-address mac mac-address
```

- Related Documentation**
- [family on page 962](#)
  - [mac-validate on page 1050](#)
  - [MAC Address Validation on Static Ethernet Interfaces Overview on page 231](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors

---

The Junos OS provides the **no-neighbor-learn** configuration statement at the **[edit interfaces *interface-name* unit *interface-unit-number* family inet]** and **[edit interfaces *interface-name* unit *interface-unit-number* family inet6]** hierarchy levels.

To disable ARP address learning by not sending arp-requests and not learning from ARP replies for IPv4 neighbors, include the **no-neighbor-learn** statement at the **[edit interfaces *interface-name* unit *interface-unit-number* family inet]** hierarchy level:

```
[edit interfaces interface-name unit interface-unit-number family inet]
no-neighbor-learn;
```

To disable neighbor discovery for IPv6 neighbors, include the **no-neighbor-learn** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family inet6]** hierarchy level:

```
[edit interfaces interface-name unit interface-unit-number family inet6]
no-neighbor-learn;
```

**Related  
Documentation**

- *Configuring Junos OS ARP Learning and Aging Options for Mapping IPv4 Network Addresses to MAC Addresses*
- *Ethernet Interfaces Feature Guide for Routing Devices*



## CHAPTER 12

# Configuring 802.1Q VLANs

- [802.1Q VLANs Overview on page 236](#)
- [802.1Q VLAN IDs and Ethernet Interface Types on page 237](#)
- [Configuring Dynamic 802.1Q VLANs on page 238](#)
- [Enabling VLAN Tagging on page 239](#)
- [Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 241](#)
- [Binding VLAN IDs to Logical Interfaces on page 242](#)
- [Associating VLAN IDs to VLAN Demux Interfaces on page 246](#)
- [Configuring VLAN and Extended VLAN Encapsulation on page 247](#)
- [Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 248](#)
- [Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 250](#)
- [Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 251](#)
- [Configuring Access Mode on a Logical Interface on page 252](#)
- [Configuring a Logical Interface for Trunk Mode on page 252](#)
- [Configuring the VLAN ID List for a Trunk Interface on page 253](#)
- [Configuring a Trunk Interface on a Bridge Network on page 253](#)
- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 256](#)
- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 256](#)
- [Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 257](#)
- [Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 258](#)
- [Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs on page 260](#)
- [Specifying the Interface to Handle Traffic for a CCC on page 261](#)
- [Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 262](#)

## 802.1Q VLANs Overview

---

For Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, 10-Gigabit Ethernet, and aggregated Ethernet interfaces supporting VPLS, the Junos OS supports a subset of the IEEE 802.1Q standard for channelizing an Ethernet interface into multiple logical interfaces, allowing many hosts to be connected to the same Gigabit Ethernet switch, but preventing them from being in the same routing or bridging domain.

### Related Documentation

- [Configuring Dynamic 802.1Q VLANs on page 238](#)
- [802.1Q VLAN IDs and Ethernet Interface Types on page 237](#)
- [Enabling VLAN Tagging on page 239](#)
- [Binding VLAN IDs to Logical Interfaces on page 242](#)
- [Configuring VLAN and Extended VLAN Encapsulation on page 247](#)
- [Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs on page 260](#)
- [Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 248](#)
- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 248](#)
- [Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 249](#)
- [Specifying the Interface to Handle Traffic for a CCC on page 249](#)
- [Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 257](#)
- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 256](#)
- [Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 258](#)
- [Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 250](#)
- [Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 258](#)
- [Configuring Access Mode on a Logical Interface on page 252](#)
- [Configuring a Logical Interface for Trunk Mode on page 252](#)
- [Configuring the VLAN ID List for a Trunk Interface on page 253](#)
- [Configuring a Trunk Interface on a Bridge Network on page 253](#)
- [\*Ethernet Interfaces Feature Guide for Routing Devices\*](#)



## 802.1Q VLAN IDs and Ethernet Interface Types

You can partition the router into up to 4095 different VLANs—depending on the router model and the physical interface types—by associating logical interfaces with specific VLAN IDs.

VLAN ID 0 is reserved for tagging the priority of frames. VLAN IDs 1 through 511 are reserved for normal VLANs. VLAN IDs 512 and above are reserved for VLAN circuit cross-connect (CCCs).

For Gigabit Ethernet IQ interfaces and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), you can configure flexible Ethernet services encapsulation on the physical interface. With flexible Ethernet services encapsulation, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

The maximum number of user-configurable VLANs is 15 on each port of the Dense-FE PIC (8-port/12-port/48-port).

[Table 15 on page 237](#) lists VLAN ID range by interface type.

**Table 15: VLAN ID Range by Interface Type**

Interface Type	VLAN ID Range
Aggregated Ethernet for Fast Ethernet	1 through 1023
Aggregate Ethernet for Gigabit Ethernet	1 through 4094
4-port, 8-port, and 12-port Fast Ethernet	1 through 1023
48-port Fast Ethernet	1 through 4094
Tri-Rate Ethernet copper	1 through 4094
Gigabit Ethernet	1 through 4094
Gigabit Ethernet IQ	1 through 4094
10-Gigabit Ethernet	1 through 4094
Management and internal Ethernet interfaces	1 through 1023



**NOTE:** For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the built-in Gigabit Ethernet port on the M7i router), VLAN IDs on a single interface can differ from each other.

Because IS-IS has an 8-bit limit for broadcast multiaccess media, you cannot set up more than 255 adjacencies over Gigabit Ethernet using VLAN tagging. For more information, see the *Junos OS Routing Protocols Library for Routing Devices*.

**Related  
Documentation**

- [802.1Q VLANs Overview on page 236](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Dynamic 802.1Q VLANs

---

You can configure the router to dynamically create VLANs when a client accesses an interface and requests a VLAN ID that does not yet exist. When a client accesses a VLAN interface, the router instantiates a VLAN dynamic profile that you have associated with the interface. Using the settings in the dynamic profile, the router extracts information about the client from the incoming packet (for example, the interface and unit values), saves this information in the routing table, and creates a VLAN or stacked VLAN ID for the client from a range of VLAN IDs that you configure for the interface.

Dynamically configuring VLANs or stacked VLANs requires the following general steps:

1. Configure a dynamic profile for dynamic VLAN or dynamic stacked VLAN creation.
2. Associate the VLAN or stacked VLAN dynamic profile with the interface.
3. Specify the Ethernet packet type that the VLAN dynamic profile accepts.
4. Define VLAN ranges for use by the dynamic profile when creating VLAN IDs.

For procedures on how to configure dynamic VLANs and dynamic stacked VLANs for client access, see the *Junos OS Broadband Subscriber Management and Services Library*.

**Related  
Documentation**

- [802.1Q VLANs Overview on page 236](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Enabling VLAN Tagging

You can configure the router to receive and forward single-tag frames, dual-tag frames, or a mixture of single-tag and dual-tag frames.



**NOTE:** If you configure VLAN tagging on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces on M320, M120, and T Series routers, the Junos OS creates an internal logical interface that reserves 50 Kbps of bandwidth from Gigabit Ethernet IQ interfaces and 2 Mbps of bandwidth from Gigabit Ethernet IQ2 and IQ2-E interfaces. As a result, the effective available bandwidth for these interface types is now 999.5 Mbps and 998 Mbps, respectively.

1. To configure the router to receive and forward single-tag frames with 802.1Q VLAN tags, include the **vlan-tagging** statement at the **[edit interfaces *interface-name*]** hierarchy level:
 

```
[edit interfaces interface-name]
user@host# vlan-tagging;
```
2. To configure the routing platform to receive and forward dual-tag frames with 802.1Q VLAN tags, include the **stacked-vlan-tagging** statement at the **[edit interfaces *interface-name*]** hierarchy level:
 

```
[edit interfaces interface-name]
user@host# stacked-vlan-tagging;
```
3. Mixed tagging is supported for Gigabit Ethernet interfaces on Gigabit Ethernet IQ2 and IQ2-E, and IQ or IQE PICs on M Series and T Series routers, for all MX Series router Gigabit and 10-Gigabit Ethernet interfaces, and for aggregated Ethernet interfaces with member links in IQ2 and IQ2-E PICs or in MX Series DPCs. Mixed tagging lets you configure two logical interfaces on the same Ethernet port, one with single-tag framing and one with dual-tag framing.



**NOTE:** Mixed tagging is not supported on Fast Ethernet interfaces.

To configure mixed tagging:

- a. Configure the **flexible-vlan-tagging** statement at the **[edit interfaces *ge-fpc/pic/port* ]** hierarchy level.
 

```
[edit interfaces ge-fpc/pic/port]
user@host# flexible-vlan-tagging;
```
- b. Configure the **vlan-tags** statement with **inner** and **outer** options or the **vlan-id** statement at the **[edit interfaces *ge-fpc/pic/port* unit *logical-unit-number*]** hierarchy level:
 

```
[edit interfaces ge-fpc/pic/port unit logical-unit-number]
user@host# vlan-id number;
family family {
```

```

address address;
}
user@host# vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
family family {
    address address;
}

```



**NOTE:** When you configure the physical interface MTU for mixed tagging, you must increase the MTU to 4 bytes more than the MTU value you would configure for a standard VLAN-tagged interface.

For example, if the MTU value is configured to be 1018 on a VLAN-tagged interface, then the MTU value on a flexible VLAN tagged interface must be 1022—4 bytes more. The additional 4 bytes accommodates the future addition of a stacked VLAN tag configuration on the same physical interface.

If the same physical interface MTU value is configured on both the VLAN and flexible VLAN-tag routers, the L2 circuit configuration does not come up and a MTU mismatch is logged. However, normal traffic flow is unaffected.

For encapsulation type **flexible-ethernet-services**, all VLAN IDs are valid.

4. For 1-, 4-, and 8-port Gigabit Ethernet IQ2 and IQ2-E PICs, for 1-port 10-Gigabit Ethernet IQ2 and IQ2-E PICs, for all MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces configured for 802.1Q flexible VLAN tagging, and for aggregated Ethernet interfaces on IQ2 and IQ2-E PICs or MX Series DPCs, you can configure mixed tagging support for untagged packets on a port. Untagged packets are accepted on the same mixed VLAN-tagged port. To accept untagged packets, include the **native-vlan-id** statement and the **flexible-vlan-tagging** statement at the **[edit interfaces *interface-name*]** hierarchy level:

```

[edit interfaces ge-fpc/pic/port]
flexible-vlan-tagging;
native-vlan-id number;

```

The logical interface on which untagged packets are to be received must be configured with the same native VLAN ID as that configured on the physical interface. To configure the logical interface, include the **vlan-id** statement (matching the **native-vlan-id** statement on the physical interface) at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level.

#### Related Documentation

- [802.1Q VLANs Overview on page 236](#)
- [Configuring VLAN and Extended VLAN Encapsulation on page 247](#)
- [Stacking a VLAN Tag on page 493](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers

---

This topic describes how to configure flexible VLAN tagging on PTX Series Packet Transport Routers. In addition to VLAN tagging and stacked VLAN tagging, you can configure a port for flexible tagging. With flexible VLAN tagging, you can configure two logical interfaces on the same Ethernet port, one with single-tag framing and one with dual-tag framing.

To configure mixed tagging, include the **flexible-vlan-tagging** statement at the **[edit interfaces et-fpc/pic/port]** hierarchy level. You must also include the **vlan-tags** statement with **inner** and **outer** options or the **vlan-id** statement at the **[edit interfaces et-fpc/pic/port unit logical-unit-number]** hierarchy level:

```
[edit interfaces et-fpc/pic/port]
flexible-vlan-tagging;
unit logical-unit-number {
    vlan-id number;
}
unit logical-unit-number {
    vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
}
```

- Related Documentation**
- [Enabling VLAN Tagging on page 239](#)

## Binding VLAN IDs to Logical Interfaces

This topic describes how to configure logical interfaces to receive and forward VLAN-tagged frames:

To configure a logical interface to receive and forward VLAN-tagged frames, you must bind a VLAN ID, a range of VLAN IDs, or a list of VLAN IDs to the logical interface.

Table 16 on page 242 lists the configuration statements you use to bind VLAN IDs to logical interfaces, organized by scope of the VLAN IDs used to match incoming packets. You can configure these statements at the `[edit interfaces interface-name unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]` hierarchy level.

Table 16: Configuration Statements Used to Bind VLAN IDs to Logical Interfaces

Scope of VLAN ID Matching	Type of VLAN Framing Supported on the Logical Interface	
	Single-Tag Framing	Dual-Tag Framing
VLAN ID	<code>vlan-id <i>vlan-id</i>;</code>	<code>vlan-tags outer <i>tpid</i>.&lt;<i>vlan-id</i>&gt; inner <i>tpid</i><i>vlan-id</i>;</code>
VLAN ID Range	<code>vlan-id-range <i>vlan-id</i>–<i>vlan-id</i>;</code>	<code>vlan-tags outer <i>tpid</i>.<i>vlan-id</i> inner-range <i>tpid</i>.<i>vlan-id</i>–<i>vlan-id</i>;</code>
VLAN ID List	<code>vlan-id-list [<i>vlan-id</i> <i>vlan-id</i>–<i>vlan-id</i>];</code>	<code>vlan-tags outer &lt;<i>tpid</i>.&gt;<i>vlan-id</i> inner-list [<i>vlan-id</i> <i>vlan-id</i>–<i>vlan-id</i>];</code>



**NOTE:** The inner-list option of the `vlan-tags` statement does not support Tag Protocol ID (TPID) values.

1. A logical interface that you have associated (bound) to a particular VLAN ID will receive and forward incoming frames that contain a matching VLAN ID. To bind a VLAN ID to a single-tag logical interface, include the `vlan-id` statement at the `[edit interfaces interface-name unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]` hierarchy level.

```
[edit interfaces interface-name unit logical-unit-number]
user@host# vlan-id vlan-id;
```

To configure an Ethernet interface to support single-tag logical interfaces, include the `vlan-tagging` statement at the `[edit interfaces ethernet-interface-name]` hierarchy level. To support mixed tagging, include the `flexible-vlan-tagging` statement instead.

2. To bind a VLAN ID to a dual-tag logical interface, include the `vlan-tags` statement at the `[edit interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level:

```
[edit interfaces ethernet-interface-name unit logical-unit-number]
vlan-tags inner <tpid.>vlan-id outer <tpid.>vlan-id;
```

To configure an Ethernet interface to support dual-tag logical interfaces, include the **stacked-vlan-tagging** statement at the **[edit interfaces *ethernet-interface-name*]** hierarchy level. To support mixed tagging, include the **flexible-vlan-tagging** statement instead.

3. A VLAN range can be used by service providers to interconnect multiple VLANs belonging to a particular customer over multiple sites. Using a VLAN ID range conserves switch resources and simplifies configuration. To bind a range of VLAN IDs to a single-tag logical interface, include the **vlan-id-range** statement at the **[edit interfaces *ethernet-interface-name* unit *logical-unit-number*]** hierarchy level or at the **[edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]** hierarchy level.

```
[edit interfaces ethernet-interface-name unit logical-unit-number]
vlan-id-range vlan-id-vlan-id;
```

4. To bind a range of VLAN IDs to a dual-tag logical interface, include the **vlan-tags** statement. Use the **inner-list** option to specify the VLAN IDs as an inclusive range by separating the starting VLAN ID and ending VLAN ID with a hyphen. You can include the statement at the **[edit interfaces *ethernet-interface-name* unit *logical-unit-number*]** hierarchy level or at the **[edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]** hierarchy level.

```
[edit interfaces ethernet-interface-name unit logical-unit-number]
vlan-tags inner-list [ vlan-id vlan-id-vlan-id ] outer <tpid>vlan-id;
```

To configure an Ethernet interface to support dual-tag logical interfaces, include the **stacked-vlan-tagging** statement at the **[edit interfaces *ethernet-interface-name*]** hierarchy level. To support mixed tagging, include the **flexible-vlan-tagging** statement instead.

In Junos OS Release 9.5 and later, on MX Series routers and in Junos OS Release 12.2R2 and later on EX Series switches, you can bind a list of VLAN IDs to a single logical interface, eliminating the need to configure a separate logical interface for every VLAN or VLAN range. A logical interface that accepts packets tagged with any VLAN ID specified in a VLAN ID list is called a *VLAN-bundled* logical interface.

You can use VLAN-bundled logical interfaces to configure circuit cross-connects between Layer 2 VPN routing instances or Layer 2 circuits. Using VLAN-bundled logical interfaces simplifies configuration and reduces use of system resources such as logical interfaces, next hops, and circuits.

As an alternative to configuring multiple logical interfaces (one for each VLAN ID and one for each range of VLAN IDs), you can configure a single VLAN-bundled logical interface based on a list of VLAN IDs.



**NOTE:** The `vlan-id` option is not supported to achieve VLAN normalization on VPLS instances that are configured with `vlan-id-list`. However, you can use the `vlan-maps` option to achieve VLAN normalization.

1. To bind a list of VLAN IDs to a single-tag logical interface, include the `vlan-id-list` statement at the `[edit interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level. Specify the VLAN IDs in the list individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.

```
[edit interfaces ethernet-interface-name unit logical-unit-number]  
user@host# vlan-id-list [ vlan-id vlan-id-vlan-id ];
```

To configure an Ethernet interface to support single-tag logical interfaces, include the `vlan-tagging` statement at the `[edit interfaces ethernet-interface-name]` hierarchy level. To support mixed tagging, include the `flexible-vlan-tagging` statement instead.

2. To bind a list of VLAN IDs to a dual-tag logical interface, include the `vlan-tags` statement at the `[edit interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces ethernet-interface-name unit logical-unit-number]` hierarchy level. Use the `inner-list` option to specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.

```
[edit interfaces ethernet-interface-name unit logical-unit-number]  
user@host# vlan-tags inner-list [ vlan-id vlan-id-vlan-id ] outer <tpid>vlan-id;
```



**NOTE:** The `inner-list` option of the `vlan-tags` statement does not support Tag Protocol ID (TPID) values.



To configure an Ethernet interface to support dual-tag logical interfaces, include the **stacked-vlan-tagging** statement at the **[edit interfaces *ethernet-interface-name*]** hierarchy level. To support mixed tagging, include the **flexible-vlan-tagging** statement instead.

The following sample configuration configures two different lists of VLAN IDs on two different logical ports.

```
[edit interfaces]
ge-1/1/0 {
  vlan-tagging; # Only for single-tagging
  encapsulation flexible-ethernet-services;
  unit 10 {
    encapsulation vlan-ccc;
    vlan-id-list [20 30–40 45];
  }
}
ge-1/1/1 {
  flexible-vlan-tagging; # Only for mixed tagging
  encapsulation flexible-ethernet-services;
  unit 10 {
    encapsulation vlan-ccc;
    vlan-id-list [1 10 20 30–40];
  }
  unit 20 {
    encapsulation vlan-ccc;
    vlan-tags outer 200 inner-list [50–60 80 90–100];
  }
}
```

In the example configuration above, **ge-1/1/0** supports single-tag logical interfaces, and **ge-1/1/1** supports mixed tagging. The single-tag logical interfaces **ge-1/1/0.10** and **ge-1/1/1.20** each bundle lists of VLAN IDs. The dual-tag logical interface **ge-1/1/1.20** bundles lists of inner VLAN IDs.



**TIP:** You can group a range of identical interfaces into an interface range and then apply a common configuration to that interface range. For example, in the above example configuration, both interfaces **ge-1/1/0** and **ge-1/1/1** have the same physical encapsulation type of **flexible-ethernet-services**. Thus you can define an interface range with the interfaces **ge-1/1/0** and **ge-1/1/1** as its members and apply the encapsulation type **flexible-ethernet-services** to that defined interface range.

#### Related Documentation

- [802.1Q VLANs Overview on page 236](#)
- [Configuring Interface Ranges](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Associating VLAN IDs to VLAN Demux Interfaces

The following sections describe how to configure VLAN demux interfaces to receive and forward VLAN-tagged frames:

- [Associating VLAN IDs to VLAN Demux Interfaces Overview on page 246](#)
- [Associating a VLAN ID to a VLAN Demux Interface on page 246](#)

### Associating VLAN IDs to VLAN Demux Interfaces Overview

To configure a VLAN demux interface to receive and forward VLAN-tagged frames, you must associate a VLAN ID or dual tagged (stacked) VLAN ID to the interface.

[Table 17 on page 246](#) shows the configuration statements you use to associate VLAN IDs to VLAN demux interfaces, depending on the VLAN tag framing you use:

**Table 17: Configuration Statements Used to Associate VLAN IDs to VLAN Demux Interfaces**

	Single-Tag Framing	Dual-Tag Framing
Statement Format	<code>vlan-id <i>vlan-id</i>;</code>	<code>vlan-tags outer <i>tpid</i>.&lt;<i>vlan-id</i>&gt; inner <i>tpid</i><i>vlan-id</i>;</code>

You can include all of the statements at the following hierarchy levels:

- `[edit interfaces interface-name unit logical-unit-number]`
- `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]`
- `[edit interfaces demux0 unit logical-unit-number]`

### Associating a VLAN ID to a VLAN Demux Interface

A VLAN demux interface that you have associated to a particular VLAN ID receives and forwards incoming frames that contain a matching VLAN ID. You can associate a VLAN ID to a single-tag logical interface or to a dual-tagged (stacked) logical interface.

1. [Associating a VLAN ID to a Single-Tag VLAN Demux Interface on page 246](#)
2. [Associating a VLAN ID to a Dual-Tag VLAN Demux Interface on page 247](#)

#### Associating a VLAN ID to a Single-Tag VLAN Demux Interface

To associate a VLAN ID to a single-tag VLAN demux interface, include the `vlan-id` statement at the `[edit interfaces demux0 unit logical-unit-number]` hierarchy level:

```
vlan-id vlan-id;
```

To configure an interface to support single-tag logical interfaces, you must also include the `vlan-tagging` statement at the `[edit interfaces interface-name]` hierarchy level. To support mixed tagging, include the `flexible-vlan-tagging` statement instead.

### Associating a VLAN ID to a Dual-Tag VLAN Demux Interface

To associate a VLAN ID to a dual-tag VLAN demux interface, include the **vlan-tags** statement at the **[edit interfaces *demux0* unit *logical-unit-number*]** hierarchy level:

```
vlan-tags inner <tpid.>vlan-id outer <tpid.>vlan-id;
```

To configure an interface to support dual-tag logical interfaces, include the **stacked-vlan-tagging** statement at the **[edit interfaces *interface-name*]** hierarchy level. To support mixed tagging, include the **flexible-vlan-tagging** statement instead.

## Configuring VLAN and Extended VLAN Encapsulation

To configure encapsulation on an interface, enter the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level:

```
[edit interfaces interface-name]  
user@host# encapsulation type
```

The following list contains important notes regarding VLAN encapsulation:

- Gigabit Ethernet IQ, Gigabit Ethernet PICs with small form-factor pluggable optics (SFPs), and MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces with VLAN tagging enabled can use **flexible-ethernet-services**, **vlan-ccc**, or **vlan-vpls** encapsulation.
- Aggregated Ethernet interfaces configured for VPLS can use **flexible-ethernet-services**, **vlan-ccc**, or **vlan-vpls**.
- Ethernet interfaces in VLAN mode can have multiple logical interfaces. In CCC and VPLS modes, VLAN IDs from 1 through 511 are reserved for normal VLANs, and VLAN IDs 512 through 4094 are reserved for CCC or VPLS VLANs. For 4-port Fast Ethernet interfaces, you can use VLAN IDs 512 through 1024 for CCC or VPLS VLANs. For encapsulation type **flexible-ethernet-services**, all VLAN IDs are valid.
- For flexible Ethernet services, Ethernet VLAN CCC and VLAN VPLS, you can also configure the encapsulation type that is used inside the VLAN circuit itself. To do this, include the **encapsulation** statement at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level or at the **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]** hierarchy level.
- You cannot configure a logical interface with VLAN CCC or VLAN VPLS encapsulation unless you also configure the physical device with the same encapsulation or with flexible Ethernet services encapsulation. In general, the logical interface must have a VLAN ID of 512 or higher; if the VLAN ID is 511 or lower, it will be subject to the normal destination filter lookups in addition to source address filtering. However if you configure flexible Ethernet services encapsulation, this VLAN ID restriction is removed.
- Gigabit Ethernet, 4-port Fast Ethernet, MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, 10-Gigabit Ethernet, and aggregated Ethernet interfaces with VLAN tagging enabled can use **extended-vlan-ccc** or **extended-vlan-vpls**, which allow 802.1Q tagging.

- For extended VLAN CCC and extended VLAN VPLS encapsulation, all VLAN IDs 1 and higher are valid. VLAN ID 0 is reserved for tagging the priority of frames.
- For extended VLAN CCC, the VLAN IDs on ingress and egress interfaces must be the same. For back-to-back connections, all VLAN IDs must be the same.

**Related  
Documentation**

- [Configuring Interface Encapsulation on Physical Interfaces](#)
- [802.1Q VLANs Overview on page 236](#)
- [Configuring VPLS Interface Encapsulation](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface

This topic describes how to configure a Layer 2 VPN routing instance on a logical interface bound to a list of VLAN IDs.

- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 248](#)
- [Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 249](#)
- [Specifying the Interface to Handle Traffic for a CCC on page 249](#)

## Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the **vlan-id-list** statement or the **vlan-tags** statement on a provider edge (PE) router:

```
interfaces {
  ethernet-interface-name {
    vlan-tagging; # Support single- or dual-tag logical interfaces
    flexible-vlan-tagging; # Support mixed tagging
    encapsulation (extended-vlan-ccc | flexible-ethernet-services);
    unit logical-unit-number {
      vlan-id-list [vlan-id vlan-id-vlan-id]; # For single-tag
      vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id-vlan-id]; # For dual-tag
    }
    ...
  }
}
```

You can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems logical-system-name]**

## Specifying the Interface Over Which VPN Traffic Travels to the CE Router

To configure a Layer 2 VPN routing instance on a PE router, include the **instance-type** statement and specify the value **l2vpn**. To specify an interface connected to the router, include the **interface** statement and specify the VLAN-bundled logical interface:

```
instance-type l2vpn;
interface logical-interface-name;
```

You can include the statements at the following hierarchy levels:

- [edit routing-instances *routing-instance-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]

## Specifying the Interface to Handle Traffic for a CCC

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the following statements:

```
protocols {
  l2vpn {
    (control-word | no-control-word);
    encapsulation-type (ethernet | ethernet-vlan);
    site site-name {
      site-identifier identifier;
      interface logical-interface-name { # VLAN-bundled logical interface
        ... interface-options ...
      }
    }
  }
}
```

You can include the statements at the same hierarchy level at which you include the **instance-type l2vpn** and **interface *logical-interface-name*** statements:

- [edit routing-instances *routing-instance-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]

To enable a Layer 2 VPN routing instance on a PE router, include the **l2vpn** statement. For more information, see the *Junos OS VPNs Library for Routing Devices*.

The **encapsulation-type** statement specifies the Layer 2 protocol used for traffic from the customer edge (CE) router. If the Layer 2 VPN routing instance is being connected to a single-tag Layer 2 circuit, specify **ethernet** as the encapsulation type. If the Layer 2 VPN routing instance is being connected to a dual-tag Layer 2 circuit, specify **ethernet-vlan** as the encapsulation type.

To specify the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the **interface** statement and specify the VLAN-bundled logical interface.

## Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface

---

The following configuration shows that the single-tag logical interface **ge-1/0/5.0** bundles a list of VLAN IDs, and the logical interface **ge-1/1/1.0** supports IPv4 traffic using IP address 10.30.1.130 and can participate in an MPLS path.

```
[edit interfaces]
ge-1/0/5 {
  vlan-tagging;
  encapsulation extended-vlan-ccc;
  unit 0 { # VLAN-bundled logical interface
    vlan-id-list [513 516 520-525];
  }
}
ge-1/1/1 {
  unit 0 {
    family inet {
      address 10.30.1.1/30;
    }
    family mpls;
  }
}
```

The following configuration shows the type of traffic supported on the Layer 2 VPN routing instance:

```
[edit protocols]
rsvp {
  interface all;
  interface lo0.0;
}
mpls {
  label-switched-path lsp {
    to 10.255.69.128;
  }
  interface all;
}
bgp {
  group g1 {
    type internal;
    local-address 10.255.69.96;
    family l2vpn {
      signaling;
    }
    neighbor 10.255.69.128;
  }
}
ospf {
  traffic-engineering;
  area 0.0.0.0 {
    interface lo0.0;
    interface ge-1/1/1.0;
  }
}
```

The following configuration shows that the VLAN-bundled logical interface is the interface over which VPN traffic travels to the CE router and handles traffic for a CCC to which the VPN connects.

```
[edit routing-instances]
red {
  instance-type l2vpn;
  interface ge-1/0/5.0; # VLAN-bundled logical interface
  route-distinguisher 10.255.69.96:100;
  vrf-target target:1:1;
  protocols {
    l2vpn {
      encapsulation-type ethernet; # For single-tag VLAN logical interface
      site CE_ultima {
        site-identifier 1;
        interface ge-1/0/5.0;
      }
    }
  }
}
```



**NOTE:** Because the VLAN-bundled logical interface supports single-tag frames, Ethernet is the Layer 2 protocol used to encapsulate incoming traffic. Although the connection spans multiple VLANs, the VLANs are bundled and therefore can be encapsulated as a single VLAN.

However, with Ethernet encapsulation, the circuit signal processing does not check that the VLAN ID list is the same at both ends of the CCC connection.

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Specifying the Interface Over Which VPN Traffic Travels to the CE Router

To configure a Layer 2 VPN routing instance on a PE router, include the **instance-type** statement and specify the value **l2vpn**. To specify an interface connected to the router, include the **interface** statement and specify the VLAN-bundled logical interface:

```
instance-type l2vpn;
interface logical-interface-name;
```

You can include the statements at the following hierarchy levels:

- **[edit routing-instances *routing-instance-name*]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]**

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Access Mode on a Logical Interface

---

Enterprise network administrators can configure a single logical interface to accept untagged packets and forward the packets within a specified bridge domain. A logical interface configured to accept untagged packets is called an *access interface* or *access port*. Access interface configuration is supported on MX Series routers only.

To configure access mode on a logical interface, use the **interface-mode access** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family bridge]** hierarchy level or at the **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]** hierarchy level.

When an untagged packet is received on an access interface, the packet is accepted, the configured VLAN ID is added to the packet, and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

The following example configures a logical interface as an access port with a VLAN ID of 20:

```
[edit interfaces ge-1/2/0]
unit 0 {
  family bridge {
    interface-mode access;
    vlan-id 20;
  }
}
```

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a Logical Interface for Trunk Mode

---

As an alternative to configuring a logical interface for each VLAN, enterprise network administrators can configure a single logical interface to accept untagged packets or packets tagged with any VLAN ID specified in a list of VLAN IDs. Using a VLAN ID list conserves switch resources and simplifies configuration. A logical interface configured to accept packets tagged with any VLAN ID specified in a list is called a *trunk interface* or *trunk port*. Trunk interface configuration is supported on MX Series routers only. Trunk interfaces support integrated routing and bridging (IRB).

To configure a logical interface to accept any packet tagged with a VLAN ID that matches the list of VLAN IDs, include the **interface-mode** statement and specify the **trunk** option:

```
interface-mode trunk;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number* family bridge]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]**



- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the VLAN ID List for a Trunk Interface

To configure the list of VLAN IDs to be accepted by the trunk port, include the **vlan-id-list** statement and specify the list of VLAN IDs. You can specify individual VLAN IDs with a space separating the ID numbers, specify a range of VLAN IDs with a dash separating the ID numbers, or specify a combination of individual VLAN IDs and a range of VLAN IDs.

```
vlan-id-list [number number-number];
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family bridge interface-mode trunk]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge interface-mode trunk]

When a packet is received that is tagged with a VLAN ID specified in the trunk interface list of VLAN IDs, the packet is accepted and forwarded within the bridge domain that is configured with the matching VLAN ID.

When a packet is received that is tagged with a VLAN ID not specified in the trunk interface list of VLAN IDs, the native VLAN ID is pushed in front of the existing VLAN tag or tags and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

When an untagged packet is received on a trunk interface, the native VLAN ID is added to the packet and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

A bridge domain configured with a matching VLAN ID must be configured before the trunk interface is configured. To learn more about configuring bridge domains, see the *Junos Routing Protocols Configuration Guide*.

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a Trunk Interface on a Bridge Network

On MX Series routers, you can configure a trunk interface on a bridge network.

The following output sample shows trunk port configuration on a bridge network:

```
user@host# run show interfaces
ge-0/0/0 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
```

```

        unit 0 {
            encapsulation vlan-bridge;
            vlan-id 1;
        }
    }
    ge-2/0/0 {
        unit 0 {
            family bridge {
                interface-mode trunk;
                vlan-id-list 1-200;
            }
        }
    }
    ge-2/0/1 {
        flexible-vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 0 {
            encapsulation vlan-bridge;
            vlan-id 1;
        }
    }
}

```

If you want **igmp-snooping** to be functional for a bridge domain, then you should not configure **interface-mode** and **irb** for that bridge domain. Such a configuration commit succeeds, but IGMP snooping is not functional, and a message informing the same is displayed as shown after the sample configuration below:

```

user@host# run show configuration
interfaces {
    ge-5/1/1 {
        flexible-vlan-tagging;
        native-vlan-id 1;
        unit 0 {
            family bridge {
                interface-mode trunk;
                vlan-id-list 401;
            }
        }
    }
    irb {
        unit 401 {
            family inet {
                address 192.168.2.2/27;
            }
        }
    }
}
protocols {
    igmp {
        interface all;
    }
}
bridge-domains {
    VLAN-401 {
        vlan-id 401;
        routing-interface irb.401;
        protocols {
            igmp-snooping;
        }
    }
}
}

```

```

user@host# commit
[edit bridge-domains]
'VLAN-401'
IGMP Snooping not supported with IRB and trunk mode interface ge-5/1/1.0
commit complete

```

To achieve IGMP snooping for a bridge domain, you should use such a configuration as shown in the following example:

```

user@host# run show configuration
interfaces {
  ge-0/0/1 {
    flexible-vlan-tagging;
    native-vlan-id 1;
    encapsulation flexible-ethernet-services;
    unit 0 {
      encapsulation vlan-bridge;
      vlan-id 401;
    }
  }
  irb {
    unit 401 {
      family inet {
        address 192.168.2.2/27;
      }
    }
  }
}
protocols {
  igmp {
    interface all;
  }
}
bridge-domains {
  VLAN-401 {
    vlan-id 401;
    interface ge-0/0/1.0;
    routing-interface irb.401;
    protocols {
      igmp-snooping;
    }
  }
}

user@host# commit
commit complete

```

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *interface-mode*
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the **vlan-id-list** statement or the **vlan-tags** statement on a provider edge (PE) router:

```
interfaces {
  ethernet-interface-name {
    vlan-tagging; # Support single- or dual-tag logical interfaces
    flexible-vlan-tagging; # Support mixed tagging
    encapsulation (extended-vlan-ccc | flexible-ethernet-services);
    unit logical-unit-number {
      vlan-id-list [vlan-id vlan-id-vlan-id]; # For single-tag
      vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id-vlan-id]; # For dual-tag
    }
    ...
  }
}
```

You can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

### Related Documentation

- [802.1Q VLANs Overview on page 236](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the **vlan-id-list** statement or the **vlan-tags** statement:

```
interfaces {
  ethernet-interface-name {
    vlan-tagging; # Support single- or dual-tag logical interfaces
    flexible-vlan-tagging; # Support mixed tagging
    encapsulation (extended-vlan-ccc | flexible-ethernet-services);
    unit logical-unit-number {
      encapsulation vlan-ccc; # Required for single-tag
      vlan-id-list [vlan-id vlan-id-vlan-id]; # For single-tag
      vlan-tags outer tpid.vlan-id inner-list [vlan-id vlan-id-vlan-id]; # For dual-tag
    }
    ...
  }
}
```

You can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

For a single-tag logical interface, include the **encapsulation** statement and specify **vlan-ccc** so that CCC circuit encapsulation is used inside the Layer 2 circuit.



**NOTE:** In the case of a dual-tag logical interface, the Junos OS automatically uses the **vlan-ccc** encapsulation type.

**Related Documentation**

- [802.1Q VLANs Overview on page 236](#)
- [Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 258](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface

This topic describes how to configure a Layer 2 circuit on a logical interface bound to a list of VLAN IDs.

- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 257](#)
- [Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 258](#)

## Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the **vlan-id-list** statement or the **vlan-tags** statement:

```
interfaces {
  ethernet-interface-name {
    vlan-tagging; # Support single- or dual-tag logical interfaces
    flexible-vlan-tagging; # Support mixed tagging
    encapsulation (extended-vlan-ccc | flexible-ethernet-services);
    unit logical-unit-number {
      encapsulation vlan-ccc; # Required for single-tag
      vlan-id-list [vlan-id vlan-id-vlan-id]; # For single-tag
      vlan-tags outer tpid.vlan-id inner-list [vlan-id vlan-id-vlan-id]; # For dual-tag
    }
    ...
  }
}
```

You can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

For a single-tag logical interface, include the **encapsulation** statement and specify **vlan-ccc** so that CCC circuit encapsulation is used inside the Layer 2 circuit.



**NOTE:** In the case of a dual-tag logical interface, the Junos OS automatically uses the `vlan-ccc` encapsulation type.

## Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the following statements:

```
l2circuit {
  neighbor address {
    interface logical-interface-name {
      virtual-circuit-id number;
      no-control-word;
    }
  }
}
```

You can include the statements at the following hierarchy levels:

- `[edit protocols]`
- `[edit logical-systems logical-system-name protocols]`

To enable a Layer 2 circuit, include the `l2circuit` statement.

To configure the router as a neighbor for a Layer 2 circuit, specify the neighbor address using the `neighbor` statement.

To specify the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the `interface` statement and specify the VLAN-bundled logical interface.

## Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface

The following configuration shows that the single-tag logical interface `ge-1/0/5.0` bundles a list of VLAN IDs, and the logical interface `ge-1/1/1.0` supports IPv4 traffic using IP address 10.30.1.1/30 and can participate in an MPLS path.

```
[edit interfaces]
ge-1/0/5 {
  vlan-tagging;
  encapsulation extended-vlan-ccc;
  unit 0 { # VLAN-bundled logical interface
    vlan-id-list [513 516 520-525];
  }
}
ge-1/1/1 {
  unit 0 {
    family inet {
      address 10.30.1.1/30;
    }
    family mpls;
  }
}
```

The following configuration shows the type of traffic supported on the Layer 2 VPN routing instance, and shows that the VLAN-bundled logical interface handles traffic for a CCC to which the Layer 2 circuit connects:

```
[edit protocols]
rsvp {
  interface all;
  interface lo0.0;
}
mpls {
  label-switched-path lsp {
    to 10.255.69.128;
  }
  interface all;
}
ospf {
  traffic-engineering;
  area 0.0.0.0 {
    interface lo0.0;
    interface ge-1/1/1.0;
  }
}
ldp {
  interface ge-1/1/1.0;
  interface ge-1/0/5.0; # VLAN-bundled logical interface
  interface lo0.0;
}
l2circuit {
  neighbor 10.255.69.128 {
    interface ge-1/0/5.0 { # VLAN-bundled logical interface
      virtual-circuit-id 3;
      no-control-word;
    }
  }
}
```

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs

For MX Series routers, you can bind a list of VLAN IDs to a logical interface, configure a Layer 2 VPN routing instance or Layer 2 circuit on the logical interface, and then use the logical interface to configure a circuit cross-connect (CCC) to another Layer 2 VPN routing instance or Layer 2 circuit.

A CCC allows you to configure transparent connections between two circuits so that packets from the source circuit are delivered to the destination circuit with, at most, the Layer 2 address being changed. You configure a CCC by connecting circuit interfaces of the same type. For more information, see *Circuit and Translational Cross-Connects Overview*.



**NOTE:** The Junos OS supports binding of Ethernet logical interfaces to lists of VLAN IDs on MX Series routers only. For all other routers, you can bind an Ethernet logical interface to only a single VLAN ID or to a single range of VLAN IDs.

The following configuration guidelines apply to bundling lists of VLAN IDs to Ethernet logical interfaces used to configure CCCs:

- [Guidelines for Configuring Physical Link-Layer Encapsulation to Support CCCs on page 260](#)
- [Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs on page 260](#)

## Guidelines for Configuring Physical Link-Layer Encapsulation to Support CCCs

To enable a physical interface to support VLAN-bundled logical interfaces that you will use to configure a CCC, you must specify one of the following physical link-layer encapsulation types as the value of the **encapsulation** statement at the **[edit interfaces interface-name]** hierarchy level:

**[edit interfaces interface-name]**

**encapsulation** (extended-vlan-ccc | flexible-ethernet-services);

- **extended-vlan-ccc**—For Ethernet interfaces with standard TPID tagging.
- **flexible-ethernet-services**—For supported Gigabit Ethernet interfaces for which you want to configure multiple per-unit Ethernet encapsulations.

For more information about configuring the encapsulation on a physical interface, see *Configuring Interface Encapsulation on Physical Interfaces*.

## Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs

For VLAN-bundled logical interfaces that you use to configure a CCC, specific logical link-layer encapsulation types are used inside the circuits themselves.

[Table 18 on page 261](#) describes the logical link-layer encapsulation types used within circuits connected using VLAN-bundled logical interfaces of the same type.



Table 18: Encapsulation Inside Circuits CCC-Connected by VLAN-Bundled Logical Interfaces

Encapsulation Inside the Circuit	Layer 2 Circuit Joined by Configuring an Interface-to-Interface CCC Connection	
	Layer 2 VPN Routing Instance	Layer 2 Circuit
Syntax	encapsulation-type (ethernet   ethernet-vlan);	encapsulation vlan-ccc;
Hierarchy Level	[edit routing-instances <i>routing-instance-name</i> protocols l2vpn], [edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn]	[edit interfaces <i>ethernet-interface-name</i> unit <i>logical-unit-number</i> ], [edit logical-systems <i>logical-system-name</i> interfaces <i>ethernet-interface-name</i> unit <i>logical-unit-number</i> ]
Usage Guidelines	See the <i>Junos OS VPNs Library for Routing Devices</i> .	See <i>Configuring Interface Encapsulation on Logical Interfaces, Circuit and Translational Cross-Connects Overview</i> , and <i>Defining the Encapsulation for Switching Cross-Connects</i> .
For a Single-Tag Logical Interface	The MX Series router automatically uses <b>ethernet</b> as the Layer 2 protocol used to encapsulate incoming traffic. Although the connection spans multiple VLANs, the VLANs are bundled and therefore can be encapsulated as a single VLAN.  <b>NOTE:</b> With <b>ethernet</b> encapsulation, the circuit signal processing does not check that the VLAN ID list is the same at both ends of the CCC connection.	Configure the MX Series router to use <b>vlan-ccc</b> as the logical link-layer encapsulation type.
For a Dual-Tag Logical Interface	Configure the MX Series router to use <b>ethernet-vlan</b> as the Layer 2 protocol to encapsulate incoming traffic.  With <b>ethernet-vlan</b> encapsulation, circuit signal processing checks that the VLAN ID list is the same at both ends of the CCC connection. If a VLAN ID list mismatch is detected, you can view the error condition in the <b>show interfaces</b> command output.	The MX Series router automatically uses <b>vlan-ccc</b> as the logical link-layer encapsulation type, regardless of the value configured.

- Related Documentation**
- [802.1Q VLANs Overview on page 236](#)
  - [Binding VLAN IDs to Logical Interfaces on page 242](#)
  - [Defining the Encapsulation for Switching Cross-Connects](#)

## Specifying the Interface to Handle Traffic for a CCC

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the following statements:

```
protocols {
  l2vpn {
    (control-word | no-control-word);
    encapsulation-type (ethernet | ethernet-vlan);
    site site-name {
      site-identifier identifier;
```

```
        interface logical-interface-name { # VLAN-bundled logical interface
            ...interface-options ...
        }
    }
}
```

You can include the statements at the same hierarchy level at which you include the **instance-type l2vpn** and **interface *logical-interface-name*** statements:

- **[edit routing-instances *routing-instance-name*]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]**

To enable a Layer 2 VPN routing instance on a PE router, include the **l2vpn** statement. For more information, see the *Junos OS VPNs Library for Routing Devices*.

The **encapsulation-type** statement specifies the Layer 2 protocol used for traffic from the customer edge (CE) router. If the Layer 2 VPN routing instance is being connected to a single-tag Layer 2 circuit, specify **ethernet** as the encapsulation type. If the Layer 2 VPN routing instance is being connected to a dual-tag Layer 2 circuit, specify **ethernet-vlan** as the encapsulation type.

To specify the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the **interface** statement and specify the VLAN-bundled logical interface.

**Related  
Documentation**

- [802.1Q VLANs Overview on page 236](#)
- [Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 250](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the following statements:

```
l2circuit {
    neighbor address {
        interface logical-interface-name {
            virtual-circuit-id number;
            no-control-word;
        }
    }
}
```

You can include the statements at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

To enable a Layer 2 circuit, include the **l2circuit** statement.

To configure the router as a neighbor for a Layer 2 circuit, specify the neighbor address using the **neighbor** statement.

To specify the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the **interface** statement and specify the VLAN-bundled logical interface.

**Related  
Documentation**

- [802.1Q VLANs Overview on page 236](#)
- [Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 258](#)
- [Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 256](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*



# Configuring Private VLANs

- [Understanding Private VLANs on MX Series Routers on page 265](#)
- [Bridge Domains Setup in PVLANS on MX Series Routers on page 271](#)
- [Bridging Functions With PVLANS on page 273](#)
- [Flow of Frames on PVLAN Ports Overview on page 274](#)
- [Guidelines for Configuring PVLANS on MX Series Routers on page 276](#)
- [Configuring PVLANS on MX Series Routers in Enhanced LAN Mode on page 277](#)
- [Example: Configuring PVLANS with Secondary VLAN Trunk Ports and Promiscuous Access Ports on page 279](#)
- [IRB Interfaces in Private VLANs on MX Series Routers on page 291](#)
- [Guidelines for Configuring IRB Interfaces in PVLANS on MX Series Routers on page 292](#)
- [Forwarding of Packets Using IRB Interfaces in PVLANS on page 293](#)
- [Configuring IRB Interfaces in PVLAN Bridge Domains on MX Series Routers in Enhanced LAN Mode on page 295](#)
- [Example: Configuring an IRB Interface in a Private VLAN on a Single MX Series Router on page 297](#)

## Understanding Private VLANs on MX Series Routers

---

VLANs limit broadcasts to specified users. Private VLANs (PVLANS) take this concept a step further by limiting communication within the VLAN. PVLANS accomplish this limitation by restricting traffic flows through their member router ports (which are called “private ports”) so that these ports communicate only with a specified uplink trunk port or with specified ports within the same VLAN. The uplink trunk port (or link aggregation group or LAG) is usually connected to a router, firewall, server, or provider network. Each PVLAN typically contains many private ports that communicate only with a single uplink, thereby preventing the ports from communicating with each other. PVLANS provide Layer 2 isolation between ports within the same VLAN, splitting a broadcast domain into multiple isolated broadcast subdomains and essentially putting secondary VLANs inside another primary VLAN.

PVLANS are supported on MX80 routers, on MX240, MX480, and MX960 routers with DPCs in enhanced LAN mode, on MX Series routers with MPC1, MPC2, and Adaptive Services PICs.

Just like regular VLANs, PVLANS are isolated on Layer 2 and require an external router to route traffic among them.

PVLANS are useful for restricting the flow of broadcast and unknown unicast traffic and for limiting the communication between known hosts. Service providers use PVLANS to keep their customers isolated from each other. Another typical use for a PVLAN is to provide per-room Internet access in a hotel.

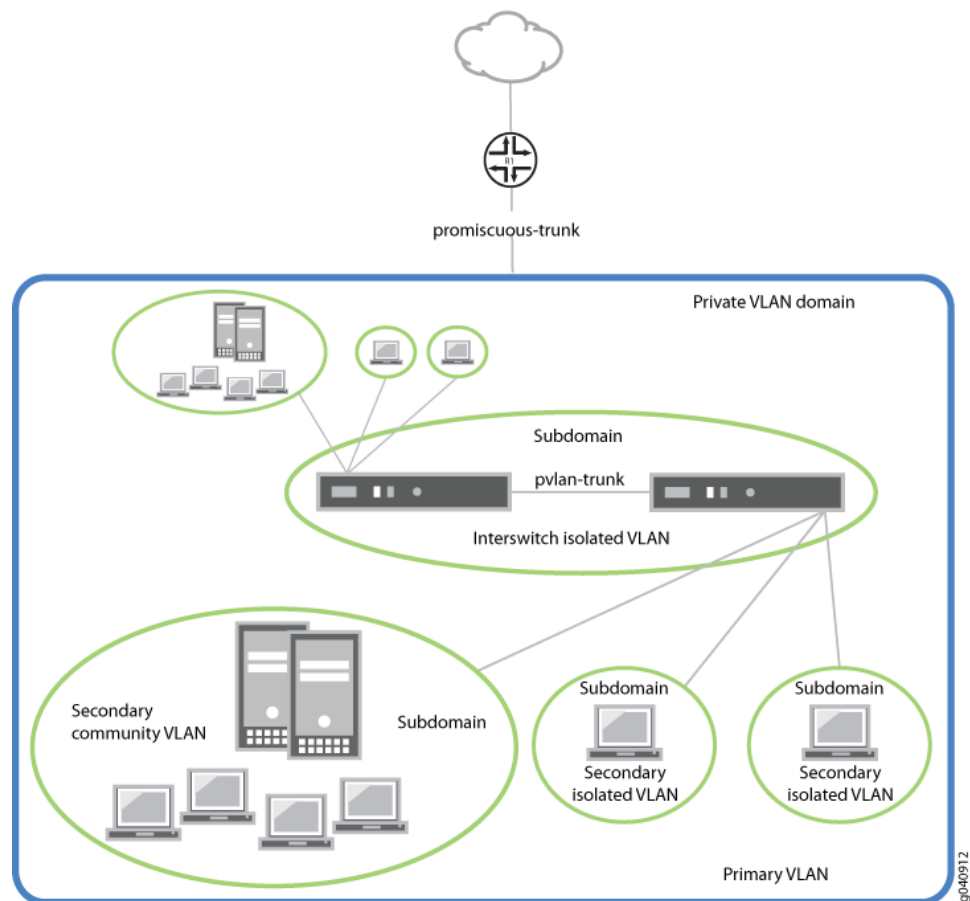
This topic explains the following concepts regarding PVLANS on MX Series routers:

- [Typical Structure and Primary Application of PVLANS on page 266](#)
- [PVLANS Use 802.1Q Tags to Identify Packets on page 267](#)
- [PVLANS Use IP Addresses Efficiently on page 268](#)
- [PVLANS Use Four Different Ethernet Switch Port Types on page 268](#)
- [Creating a PVLAN on page 269](#)

## Typical Structure and Primary Application of PVLANS

The configured PVLAN becomes the primary domain, and secondary VLANs become subdomains that are nested inside the primary domain. A PVLAN can be created on a single router. The PVLAN shown in [Figure 18 on page 267](#) includes one router, with one primary PVLAN domain and multiple secondary subdomains.

Figure 18: Subdomains in a PVLAN With One Router



The types of domains are:

- Primary VLAN—VLAN used to forward frames downstream to isolated and community VLANs.
- Secondary isolated VLAN—VLAN that receives packets only from the primary VLAN and forwards frames upstream to the primary VLAN.
- Secondary interswitch isolated VLAN—VLAN used to forward isolated VLAN traffic from one router to another through PVLAN trunk ports.
- Secondary community VLAN—VLAN used to transport frames among members of a community, which is a subset of users within the VLAN, and to forward frames upstream to the primary VLAN.

### PVLANS Use 802.1Q Tags to Identify Packets

When packets are marked with a customer-specific 802.1Q tag, that tag identifies ownership of the packets for any router or router in the network. Sometimes, 802.1Q tags are needed within PVLANS to keep track of packets from different subdomains.

[Table 19 on page 268](#) indicates when a VLAN 802.1Q tag is needed on the primary VLAN or on secondary VLANs.

Table 19: When VLANs in a PVLAN Need 802.1Q Tags

	On a Single Switch
Primary VLAN	Specify an 802.1Q tag by setting a VLAN ID.

### PVLANS Use IP Addresses Efficiently

PVLANS provide IP address conservation and efficient allocation of IP addresses. In a typical network, VLANs usually correspond to a single IP subnet. In PVLANS, the hosts in all secondary VLANs belong to the same IP subnet because the subnet is allocated to the primary VLAN. Hosts within the secondary VLAN are assigned IP addresses based on IP subnets associated with the primary VLAN, and their IP subnet masking information reflects that of the primary VLAN subnet.

### PVLANS Use Four Different Ethernet Switch Port Types

PVLANS isolate ports within the same broadcast domain. To do this, different kinds of PVLAN ports are used, with guidelines for different situations:

- **Promiscuous port**—A promiscuous port is an upstream trunk port connected to a router, firewall, server, or provider network. A promiscuous port can communicate with all interfaces, including the isolated and community ports within a PVLAN. A PVLAN typically contains a single promiscuous uplink port. Use a promiscuous port to move traffic between ports in community or isolated VLANs.
- **Community port**—Community ports communicate among themselves and with their promiscuous ports. Community ports serve only a select group of users. These interfaces are separated at Layer 2 from all other interfaces in other communities or isolated ports within their PVLAN.
- **Isolated port**—Isolated ports have Layer 2 connectivity only with promiscuous ports and PVLAN trunk ports—an isolated port cannot communicate with another isolated port even if these two ports are members of the same isolated VLAN (or interswitch isolated VLAN) domain. Typically, a server, such as a mail server or a backup server, is connected on an isolated port. In a hotel, each room would typically be connected on an isolated port, meaning that room-to-room communication is not possible, but each room can access the Internet on the promiscuous port.
- **Interswitch link port**—An interswitch link (ISL) port is a trunk port that connects two routers when a PVLAN spans those routers. The ISL port is a member of all VLANs within the PVLAN (that is, the primary VLAN, the community VLANs, and the isolated VLAN).

Communication between an ISL port and an isolated port is unidirectional. An ISL port's membership in the interswitch isolated VLAN is egress-only, meaning that incoming traffic on the ISL port is never assigned to the isolated VLAN. An isolated port can forward packets to a PVLAN trunk port, but a PVLAN trunk port cannot forward packets to an isolated port. [Table 20 on page 269](#) summarizes whether Layer 2 connectivity exists between the different types of ports.



Table 20: PVLAN Ports and Layer 2 Connectivity

Port Type	Promiscuous Port	Community Port	Isolated Port	PVLAN Trunk Port
Promiscuous	Yes	Yes	Yes	Yes
Community	Yes	Yes—same community only.	No	Yes
Isolated	Yes	No	No	Yes
				NOTE: This communication is unidirectional.
Interswitch Link	Yes	Yes—same community only.	Yes	Yes
			This communication is unidirectional.	



**NOTE:** If you enable no-mac-learning on a primary VLAN, all isolated VLANs (or the interswitch isolated VLAN) in the PVLAN inherit that setting. However, if you want to disable MAC address learning on any community VLANs, you must configure no-mac-learning on each of those VLANs.

## Creating a PVLAN

The flowchart shown in [Figure 19 on page 270](#) gives you a general idea of the process for creating PVLANs. If you complete your configuration steps in the order shown, you will not violate these PVLAN rules. (In the PVLAN rules, configuring the PVLAN trunk port applies only to a PVLAN that spans multiple routers.)

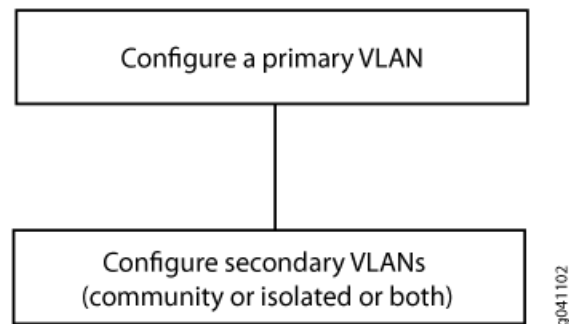
- The primary VLAN must be a tagged VLAN.
- If you are going to configure a community VLAN ID, you must first configure the primary VLAN.
- If you are going to configure an isolation VLAN ID, you must first configure the primary VLAN.



**NOTE:** Configuring a voice over IP (VoIP) VLAN on PVLAN interfaces is not supported.

Configuring a VLAN on a single router is relatively simple, as shown in [Figure 19 on page 270](#).

Figure 19: Configuring a PVLAN on a Single Switch



Configuring a primary VLAN consists of these steps:

1. Configure the primary VLAN name and 802.1Q tag.
2. Set **no-local-switching** on the primary VLAN.
3. Configure the promiscuous trunk port and access ports.
4. Make the promiscuous trunk and access ports members of the primary VLAN.

Within a primary VLAN, you can configure secondary community VLANs or secondary isolated VLANs or both. Configuring a secondary community VLAN consists of these steps:

1. Configure a VLAN using the usual process.
2. Configure access interfaces for the VLAN.
3. Assign a primary VLAN to the community VLAN,

Isolated VLANs are created internally when the isolated VLAN has access interfaces as members and the option **no-local-switching** is enabled on the primary VLAN.

802.1Q tags are required for interswitch isolated VLANs because IEEE 802.1Q uses an internal tagging mechanism by which a trunking device inserts a 4-byte VLAN frame identification tab into the packet header.

Trunk ports are only needed for multirouter PVLAN configurations—the trunk port carries traffic from the primary VLAN and all secondary VLANs.

#### Related Documentation

- [Bridge Domains Setup in PVLANS on MX Series Routers on page 271](#)
- [Bridging Functions With PVLANS on page 273](#)
-

## Bridge Domains Setup in PVLANS on MX Series Routers

Bridge domain capabilities are used to support PVLANS on MX Series routers. Although this functionality is similar to the PVLAN mechanism on EX Series switches, the difference is that only one isolation VLAN can be configured for all isolated ports on MX routers instead of one isolation VLAN permissible per isolated port on EX Series switches.

Assume a sample deployment in which a primary VLAN named VP contains ports p1, p2, t1, t2, i1, i2, cx1, and cx2. The port types of these configured ports are as follows:

- Promiscuous ports = p1, p2
- ISL ports = t1, t2
- Isolated ports = i1, i2
- Community VLAN = Cx
- Community ports = cx1, cx2

Bridge domains are provisioned for each of the VLANs, namely, Vp, Vi, and Vcx. Assume the bridge domains to be configured as follows:

Vp—BD\_primary\_Vp (ports contained are p1, t1, i1, i2, cx1, cx2)

Vi—BD\_isolate\_Vi (ports contained are p1, t1, \*i1, \*i2)

Vcx—BD\_community\_Vcx (ports contained are p1, t1, cx1, cx2)

The bridge domains for community, primary, and isolated VLANs are automatically created by the system internally when you configure a bridge domain with a trunk interface, access interface, or interswitch link. The bridge domains contain the same VLAN ID corresponding to the VLANs. To use bridge domains for PVLANS, you must configure the following additional attributes:

- **community-vlans** option—This option is specified on all community vlans and for community BDs created internally.
- **isolated-vlan** option—This option denotes the vlan tag to be used for isolation BD created internally for each PVLAN/BD. This setting is required.
- **inter-switch-link** option with the **interface-mode trunk** statement at the **[edit interfaces interface-name family bridge]** or the **[edit interfaces interface-name unit logical-unit-number family bridge]** hierarchy level—This configuration specifies whether the particular interface assumes the role of interswitch link for the PVLAN domains of which it is a member.

You can use the **vlan-id** configuration statement for PVLAN ports to identify the port role. All the logical interfaces involved in PVLANS must be configured with a VLAN ID and the Layer 2 process uses this VLAN tag to classify a port role as promiscuous, isolated, or community port by comparing this value with the VLANs configured in the PVLAN bridge domain (using the **bridge-domains** statement at the **[edit]** hierarchy level). The ISL port role is identified by the **inter-switch-link** option. The VLAN ID for ISL port is required and

must be set to the primary VLAN ID. The ISL must be a trunk interface. A list of VLAN IDs is not needed because the Layer 2 process creates such a list internally based on PVLAN bridge domain configuration. For untagged promiscuous, isolated or community, logical interfaces or ports, access mode must be used as the interface mode. For tagged promiscuous, isolated, or community interfaces, trunk mode must be specified as the interface mode.

The bridge domain interface families are enhanced to include ingress-only and egress-only association. The association for the interface family bridge domain (IFBD) is created in the following manner:

- For BD\_primary\_Vp, IFBD for i1, i2, cx1 and cx2 are egress only.
- BD\_isolate\_Vi, IFBD for p1 will be egress only and for i1 and i2 are ingress only.
- BD\_community\_Vcx, IFBD for p1 are egress only. VLAN translation rules ensure the following VLAN mappings to work properly:
  - VLAN mapping on promiscuous ports: On promiscuous ports, the Vlan Vi is mapped to Vlan Vp on egress interfaces. Similarly on promiscuous ports, Vcx is also be mapped to Vp.
  - VLAN mapping on isolation ports: On tagged isolated ports, the VLAN tag, Vp, is mapped to Vi on egress.
  - VLAN mapping on community ports: On tagged community ports, the VLAN tag, Vp, is mapped to Vcx on egress.

A management bridge domain for PVLAN that exists only in the Layer 2 address learning process called PBD to denote bridge domain for VLAN is used by the system. This bridge domain has the same name as the user-configured name. Under this bridge domain, one primary PVLAN bridge domain for the primary vlan, one isolation bridge domain for the isolation vlan, and one community bridge domain for each community vlan are programmed internally. You might find separate bridge domains for the PVLAN ports to be useful if you want to configure a policy for a specific community VLAN or isolation VLAN.

The management bridge domain maintains a list to include all internal bridge domains that belong to this PVLAN bridge domain. Isolation and community bridge domains contain a pointer or a flag to indicate that this bridge domain is for PVLANS and maintain the information about the primary bridge domain index and primary VLAN. All this information is available across the bridge domain interfaces that are mapped to this bridge domain. MAC learning occurs only in the primary bridge domain and the MAC forwarding entry is programmed into the primary bridge domain only. As a result, the isolation bridge domain and all community bridge domains share the same forwarding table as the primary bridge domain.

For the isolation bridge domain, BD\_isolate\_Vi, isolation port i1 and i2 function as a non-local-switch access port and the flood group for this bridge domain contains only the promiscuous port, p1, and ISL ports, t1 and t2.

---

## Bridging Functions With PVLANs

---

This topic describes how bridging is implemented on MX Series routers that will help with understanding the unique enhancements involved in implementing PVLAN bridging procedures. Consider two ports in a bridging domain with the respective ports on different FPCs and different Packet Forwarding Engines. When a packet enters a port, the following is the flow, assuming it is a tagged packet:

1. As the starting process, a VLAN lookup is performed to determine which bridging domain the packet forms. The result of the lookup identifies the bridging domain id (bd\_id), mesh group id (mg\_id). With these parameters, other related information configured for this bridging domain is discovered.
2. A source MAC address (SMAC) lookup is performed to find out whether this MAC addresses is learned or not. If it is not a learned address, an MLP packet (route for flooding traffic to MAC learning chips) is sent to all the other Packet Forwarding Engines that are mapped with this bridging domain. In addition, an MLP packet is also sent to the host.
3. A destination MAC address (DMAC) lookup using the tuple (bridge domain ID, VLAN, and destination MAC address).
4. If a match is observed for the MAC address, the result of the lookup points to the egress next-hop. The egress Packet Forwarding Engine is used to forward the packet.
5. If a miss occurs during the lookup, the flood next-hop is determined using the mesh group ID to flood the packet.

The following two significant conditions are considered in PVLAN bridging: Only a specific port to another port forwarding is permitted. A packet drop occurs on the egress interface after traversing and consuming the fabric bandwidth. To avoid traffic dropping, the decision on whether the packet needs to be dropped arrives before traversing the fabric, thereby saving the fabric bandwidth during DoS attacks. Because multiple overlapping bridge domains exist, which denotes that the same port (promiscuous or interswitch link) appears as a member in multiple bridge domains, the MAC addresses learned in one port must be visible to ports on another bridge domain. For example, a MAC address learned on a promiscuous port must be visible to both an isolated port (isolated bridge domain) and a community port (community bridge domain) on the various community bridge domains.

To resolve this problem, a shared VLAN is used for PVLAN bridging. In the shared VLAN model, all the MACs learned across all the ports are stored in the same bridge domain (primary VLAN BD) and same VLAN (primary VLAN). When the VLAN lookup is done for the packet, the PVLAN port, PVLAN bridge domain, and the PVLAN tag or ID are also used. The following processes occur with a shared VLAN methodology:

- A source MAC address (SMAC) lookup is performed to find out whether this MAC address is learned or not. If it is not a learned address, an MLP packet (route for flooding traffic to MAC learning chips) is sent to all the other Packet Forwarding Engines that are mapped with this bridging domain. In addition, an MLP packet is also sent to the host.
- A destination MAC address (DMAC) lookup using the tuple (bridge domain ID, VLAN, and destination MAC address).
- If a match is observed for the MAC address, the result of the lookup points to the egress next-hop. The egress Packet Forwarding Engine is used to forward the packet.
- If a miss occurs during the lookup, the flood next-hop is determined using the mesh group ID to flood the packet.
- If a match occurs, the group ID is derived from the VLAN lookup table and the following validation is performed to enforce primary VLAN forwarding:

Steps	Source	Destination	Action
Step 1	0	{*}	Permit
Step 2	{*}	0	Permit
Step 3	1	1	Drop
Step 4	X <-> Y (X > 1 and Y > 1 and X ≠ Y Drop		

Here, {\*} is a wildcard in regular expression notation referring to any value. Step 1 ensures all forwarding from promiscuous or inter switch link ports to any other port is permitted. Step 2 ensures all forwarding from any port to promiscuous or interswitch link ports is permitted. Step 3 ensures any isolated port to another isolated port is dropped. Step 4 ensures community port forwarding is permitted only within same community (X == Y) and dropped when its across community (X ff Y).

#### Related Documentation

## Flow of Frames on PVLAN Ports Overview

This topic describes the manner in which traffic that enters the different PVLAN ports, such as promiscuous, isolated, and interswitch link VLANs, is processed. Sample configuration scenarios are used to describe the transmission and processing of packets.

Assume a sample deployment in which a primary VLAN named VP contains ports, p1, p2, t1, t2, i1, i2, cx1, and cx2. The port types of these configured ports are as follows:

- Promiscuous ports = p1, p2
- ISL ports = t1, t2
- Isolated ports = i1, i2
- Community VLAN = Cx
- Community ports = cx1, cx2

Bridge domains are provisioned for each of the VLANs, namely, Vp, Vi, and Vcx. Assume the bridge domains to be configured as follows:

Vp—BD\_primary\_Vp (ports contained are p1, t1, i1, i2, cx1, cx2)

Vi—BD\_isolate\_Vi (ports contained are p1, t1, \*i1, \*i2)

Vcx—BD\_community\_Vcx (ports contained are p1, t1, cx1, cx2)

The bridge domains for community, primary, and isolated VLANs are automatically created by the system internally when you configure a bridge domain with a trunk interface, access interface, or interswitch link. The bridge domains contain the same VLAN ID corresponding to the VLANs. To use bridge domains for PVLANS, you must configure the following additional attributes:

### Ingress Traffic on Isolated Ports

Consider an ingress port, i1. i1 is mapped to a bridge domain named BD\_isolate\_Vi. BD\_isolate\_Vi does not have any isolated ports as an egress member. Frames can only be sent in the egress direction on p1 and t1. When a frame is sent out on p1, it is tagged with the tag of Primary VLAN Vp. A VLAN translation of Vi to Vp is performed. When a frame is propagated out of t1, it is tagged with the tag Vi.

### Ingress Traffic on Community ports

Consider an ingress port as cx1. cx1 is mapped to bridge domain BD\_community\_Vcx. Because of the VLAN membership with the bridge domain, frames can be sent out of p1, t1, cx1, cx2. When a frame is traversed out on p1, it is tagged with tag of Primary VLAN Vp [VLAN translation]. When a frame goes out of t1, it is tagged with tag Vcx.

### Ingress Traffic on Promiscuous Ports

Consider a promiscuous port p1 as the ingress port. p1 is mapped to bridge domain BD\_primary\_Vp. Frames can go out of any member port. When a frame goes out of t1, it is tagged with tag Vp. If another promiscuous port exists, that frame is also sent out with Vp.

### Ingress Traffic on Interswitch Links

With the Vlan tag Vp, assume the ingress port as t1 mapped to bridge domain BD\_primary\_Vp. Frames can go out of any member port. When a frame goes out of p1, it is tagged with tag Vp. With the Vlan tag Vi, t1 mapped to bridge domain BD\_isolate\_Vi. The frame can not egress isolated ports as they are ingress-only members of BD\_isolate\_Vi. When a frame goes out on p1, it is tagged with tag of Primary VLAN Vp (VLAN translation). When a frame goes out of any other trunk port, it contains the Vi tag. With the Vlan tag Vcx, t1 is mapped to BD\_community\_Vcx. Frames can go out of p1, t1, cx1, and cx2. When a frame goes out on p1, it is tagged with the tag of primary VLAN Vp (VLAN translation).

### Packet Forwarding in PVLANS

Consider a primary VLAN with the following configuration of ports:

```
Promiscuous  P1 P2
Inter Switch Link  L1 L2
Isolated      I1 I2
```

```

Community1    C11 C12
Community2    C21 C22

```

Internally, one global BD called the primary vlan BD is created that consists of all the ports. One isolation bridge domain consisting of all isolation ports in addition the promiscuous and ISL ports and one bridge domain per community is defined consisting of community ports in addition to the promiscuous and ISL ports internally configured in the system. The bridge domains with the PVLAN ports are as follows:

```

Primary Vlan BD P1 P2 L1 L2 I1 I2 C11 C12 C21 C22
Isolated BD      I1 I2 P1 P2 L1 L2
Community1 BD    C11 C12 P1 P2 L1 L2
Community 2 BD   C21 C22 P1 P2 L1 L2

```

The following PVLAN forwarding events take place among these ports with the appropriate VLAN translation as described in the following table:

Port Type To: → From: ↓	Isolated	Community	Promiscuous	Inter-switch Link
Isolated	Dropped	Dropped	Primary VLAN tag to Isolation VLAN tag.	If received with the primary VLAN tag, translate to the isolation VLAN Tag; else dropped
Promiscuous	Dropped	No translation if it is the same community; else dropped.	Primary VLAN tag to Community VLAN tag.	If received with primary VLAN tag, translate to community VLAN tag; else no translation if received with same community vlan else dropped.
Community	Isolated VLAN tag to Primary VLAN tag	Community VLAN tag to Primary VLAN tag	No translation	If received with isolation or community VLAN tag, translate to Primary VLAN tag; else no translation
Interswitch Link	No translation	No translation	No translation	No translation

## Guidelines for Configuring PVLANS on MX Series Routers

Consider the following guidelines while you configure PVLANS on MX Series routers that function in enhanced LAN mode:

- PVLANS are supported on MX80 routers, on MX240, MX480, and MX960 routers with DPCs in LAN mode, on MX Series routers with MPCs.
- Isolated ports, promiscuous ports, community ports, and interswitch links (ISL) adhere to the following rules of tagging and forwarding:
  - The frames received on the primary VLAN on promiscuous ports can go to any port.
  - The frames received on isolated ports can only go to promiscuous ports and ISL ports.
  - The frames received on community ports can only go to ports of the same community, promiscuous ports, and ISL ports.



- The frames received on ISL ports with an isolation VLAN tag or ID can only go to promiscuous ports or ISL ports.
- The frames received on ISL ports with a community VLAN tag can only go to promiscuous ports, ISL ports, or ports belonging to a corresponding community port.
- The frames being sent out of promiscuous ports should have a primary VLAN tag or should be untagged. It is considered untagged if the port is configured as an untagged member of the primary VLAN. The frames going out of isolated or community ports are generally untagged. However, they can also be tagged depending on the port configuration. In any case, the configured VLAN tag must be the same as the related isolated VLAN tag or community VLAN tag.
- The frames going out of ISL ports are tagged with the primary VLAN if they are received on a promiscuous port. An untagged frame cannot exit out of an ISL port in the context of a primary VLAN, isolated VLAN, or community VLAN, but for any other VLAN, it can be untagged depending on the configuration.
- The frames going out of ISL ports are tagged with an isolated VLAN (isolation ID) if received on the isolated port.
- The frames going out of ISL ports are tagged with the community VLAN tag, if it is received on the corresponding community port.
- Graceful Routing Engine switchover (GRES) is supported for PVLANS.
- A virtual switch instance that contains a bridge domain associated with logical interfaces is supported.
- Aggregated Ethernet (ae) interfaces for all types of ports are supported.
- Virtual private LAN service (VPLS) instances is not supported. Integrated routing and bridging (IRB) interfaces in PVLANS are supported.
- MX Series Virtual Chassis configuration is not supported.
- MC-LAG interfaces are not supported. All ports that are associated with PVLAN bridge domains cannot be mc-ae interfaces.
- IGMP snooping is not supported. Q-in-Q tunneling is not supported.

**Related**  
**Documentation**

---

## Configuring PVLANS on MX Series Routers in Enhanced LAN Mode

---

You can configure a private VLAN (PVLAN) on a single MX Series router to span multiple MX Series routers. VLANs limit broadcasts to specified users. You need to specify the interswitch link (ISL) for a PVLAN, the PVLAN port types, and secondary VLANs for the PVLAN. You must create a virtual switch routing instance with a bridge domain, and associate the interfaces with the bridge domain. You can specify the secondary VLANs as isolated or community VLANs in the bridge domain.

Before you begin configuring a PVLAN, make sure you have:

- Created and configured the necessary VLANs. See [“Configuring VLAN and Extended VLAN Encapsulation” on page 247](#) and [“Enabling VLAN Tagging” on page 239](#).
- Configured MX240, MX480, and MX960 routers to function in enhanced LAN mode by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level.

You must reboot the router when you configure or delete the enhanced LAN mode on the router. Configuring the **network-services lan** option implies that the system is running in the enhanced IP mode. When you configure a device to function in MX-LAN mode, only the supported configuration statements and operational show commands that are available for enabling or viewing in this mode are displayed in the CLI interface.

If your system contains parameters that are not supported in MX-LAN mode in a configuration file, you cannot commit those unsupported attributes. You must remove the settings that are not supported and then commit the configuration. After the successful CLI commit, a system reboot is required for the attributes to become effective. Similarly, if you remove the **network-services lan** statement, the system does not run in MX-LAN mode. Therefore, all of the settings that are supported outside of the MX-LAN mode are displayed and are available for definition in the CLI interface. If your configuration file contains settings that are supported only in MX-LAN mode, you must remove those attributes before you commit the configuration. After the successful CLI commit, a system reboot is required for the CLI parameters to take effect. The Layer 2 Next-Generation CLI configuration settings are supported in MX-LAN mode. As a result, the typical format of CLI configurations might differ in MX-LAN mode.

To configure a PVLAN:

1. Create a promiscuous port for the PVLAN.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode trunk
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

2. Create the interswitch link (ISL) trunk port for the PVLAN.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode trunk inter-switch-link
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

3. Create the isolated port for the PVLAN. The port is identified as an isolated port or a community port, based on the VLAN ID or the list of VLAN IDs to which the interface corresponds. For example, if you configure a port with a VLAN ID of 50, and if you specify a VLAN ID of 50 as the isolated VLAN or tag in the bridge domain, the port is considered as an isolation port.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode access
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

4. Create the community port for the PVLAN. The port is identified as an isolated port or a community port, based on the VLAN ID or the list of VLAN IDs to which the interface corresponds. For example, if you configure a port with a VLAN ID of 50, and if you specify a VLAN ID of 50 as the community VLAN or tag in the bridge domain, the port is considered as a community port.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode access
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

5. Create a virtual switch instance with a bridge domain and associate the logical interfaces.

```
[edit routing-instances]
user@host# set routing-instance-name instance-type virtual-switch
user@host# set routing-instance-name interface interface-name unit
               logical-unit-number
user@host# set routing-instance-name bridge-domains bridge-domain-name
```

6. Specify the primary, isolated, and community VLAN IDs, and associate the VLANs with the bridge domain.

```
[edit routing-instances instance-name bridge-domains bridge-domain-name]
user@host# set vlan-id vlan-id
user@host# set isolated-vlan vlan-id
user@host# set community-vlans [ number number-number ]
```

Related •  
Documentation

## Example: Configuring PVLANS with Secondary VLAN Trunk Ports and Promiscuous Access Ports

This example shows how to configure secondary VLAN trunk ports and promiscuous access ports as part of a private VLAN configuration. Secondary VLAN trunk ports carry secondary VLAN traffic.

For a given private VLAN, a secondary VLAN trunk port can carry traffic for only one secondary VLAN. However, a secondary VLAN trunk port can carry traffic for multiple secondary VLANs as long as each secondary VLAN is a member of a different private (primary) VLAN. For example, a secondary VLAN trunk port can carry traffic for a community VLAN that is part of primary VLAN pvlan100 and also carry traffic for an isolated VLAN that is part of primary VLAN pvlan400.

To configure a trunk port to carry secondary VLAN traffic, use the *isolated* and *interface* statements, as shown in steps 12 and 13 of the example configuration for Switch 1.



**NOTE:** When traffic egresses from a secondary VLAN trunk port, it normally carries the tag of the primary VLAN that the secondary port is a member of. If you want traffic that egresses from a secondary VLAN trunk port to retain its secondary VLAN tag, use the *extend-secondary-vlan-id* statement.

A promiscuous access port carries untagged traffic and can be a member of only one primary VLAN. Traffic that ingresses on a promiscuous access port is forwarded to the ports of the secondary VLANs that are members of the primary VLAN that the promiscuous access port is a member of. This traffic carries the appropriate secondary VLAN tags when it egresses from the secondary VLAN ports if the secondary VLAN port is a trunk port.

To configure an access port to be promiscuous, use the *promiscuous* statement, as shown in step 12 of the example configuration for Switch 2.

If traffic ingresses on a secondary VLAN port and egresses on a promiscuous access port, the traffic is untagged on egress. If tagged traffic ingresses on a promiscuous access port, the traffic is discarded.

- [Requirements on page 280](#)
- [Overview and Topology on page 280](#)
- [Configuring the PVLANS on Switch 1 on page 282](#)
- [Configuring the PVLANS on Switch 2 on page 286](#)
- [Verification on page 290](#)

## Requirements

This example uses the following hardware and software components:

- Two QFX devices
- Junos OS Release 12.2 or later for the QFX Series

## Overview and Topology

[Figure 20 on page 281](#) shows the topology used in this example. Switch 1 includes several primary and secondary private VLANs and also includes two secondary VLAN trunk ports configured to carry secondary VLANs that are members of primary VLANs pvlan100 and pvlan400.

Switch 2 includes the same private VLANs. The figure shows xe-0/0/0 on Switch 2 as configured with promiscuous access ports or promiscuous trunk ports. The example configuration included here configures this port as a promiscuous access port.

The figure also shows how traffic would flow after ingressing on the secondary VLAN trunk ports on Switch 1.

Figure 20: PVLAN Topology with Secondary VLAN Trunk Ports and Promiscuous Access Port

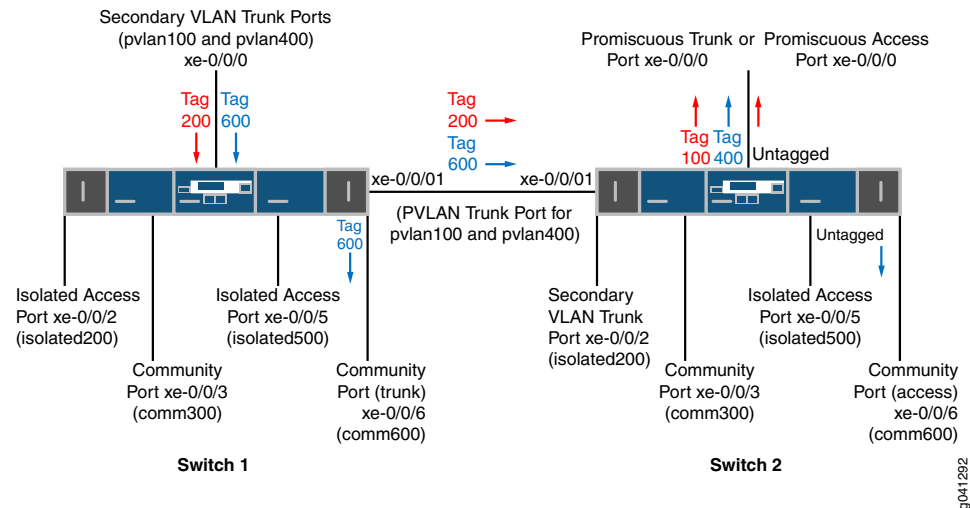


Table 21 on page 281 and Table 22 on page 282 list the settings for the example topology on both switches.

Table 21: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 1

Component	Description
pvlan100, ID 100	Primary VLAN
pvlan400, ID 400	Primary VLAN
comm300, ID 300	Community VLAN, member of pvlan100
comm600, ID 600	Community VLAN, member of pvlan400
isolation-vlan-id 200	VLAN ID for isolated VLAN, member of pvlan100
isolation-vlan-id 500	VLAN ID for isolated VLAN, member of pvlan400
xe-0/0/0.0	Secondary VLAN trunk port for primary VLANs pvlan100 and pvlan400
xe-0/0/1.0	PVLAN trunk port for primary VLANs pvlan100 and pvlan400
xe-0/0/2.0	Isolated access port for pvlan100
xe-0/0/3.0	Community access port for comm300
xe-0/0/5.0	Isolated access port for pvlan400
xe-0/0/6.0	Community trunk port for comm600

Table 22: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 2

Component	Description
pvlan100, ID 100	Primary VLAN
pvlan400, ID 400	Primary VLAN
comm300, ID 300	Community VLAN, member of pvlan100
comm600, ID 600	Community VLAN, member of pvlan400
isolation-vlan-id 200	VLAN ID for isolated VLAN, member of pvlan100
isolation-vlan-id 500	VLAN ID for isolated VLAN, member of pvlan400
xe-0/0/0.0	Promiscuous access port for primary VLANs pvlan100
xe-0/0/1.0	PVLAN trunk port for primary VLANs pvlan100 and pvlan400
xe-0/0/2.0	Secondary trunk port for isolated VLAN, member of pvlan100
xe-0/0/3.0	Community access port for comm300
xe-0/0/5.0	Isolated access port for pvlan400
xe-0/0/6.0	Community access port for comm600

### Configuring the PVLANS on Switch 1

**CLI Quick Configuration** To quickly create and configure the PVLANS on Switch 1, copy the following commands and paste them into a switch terminal window:

```
[edit]
set interfaces xe-0/0/0 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/1 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan100
set interfaces xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan400
set interfaces xe-0/0/2 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/3 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/5 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/6 unit 0 family ethernet-switching port-mode trunk
set vlans pvlan100 vlan-id 100
set vlans pvlan400 vlan-id 400
set vlans pvlan100 pvlan
set vlans pvlan400 pvlan
set vlans pvlan100 interface xe-0/0/1.0 pvlan-trunk
set vlans pvlan400 interface xe-0/0/1.0 pvlan-trunk
set vlans comm300 vlan-id 300
set vlans comm300 primary-vlan pvlan100
set vlans comm300 interface xe-0/0/3.0
set vlans comm600 vlan-id 600
set vlans comm600 primary-vlan pvlan400
set vlans comm600 interface xe-0/0/6.0
set vlans pvlan100 pvlan isolation-vlan-id 200
```

```

set vlans pvlan400 pvlan isolation-vlan-id 500
set vlans pvlan100 interface xe-0/0/0.0 isolated
set vlans pvlan400 interface xe-0/0/0.0 isolated
set vlans comm600 interface xe-0/0/0.0
set vlans pvlan100 interface xe-0/0/2.0 isolated
set vlans pvlan400 interface xe-0/0/5.0 isolated

```

### Step-by-Step Procedure

To configure the private VLANs and secondary VLAN trunk ports:

1. Configure the interfaces and port modes:

[edit interfaces]

```

user@switch# set xe-0/0/0 unit 0 family ethernet-switching port-mode trunk
user@switch# set xe-0/0/1 unit 0 family ethernet-switching port-mode trunk
user@switch# set xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan100
user@switch# set xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan400
user@switch# set xe-0/0/2 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/3 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/5 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/6 unit 0 family ethernet-switching port-mode access

```

2. Create the primary VLANs:

[edit vlans]

```

user@switch# set pvlan100 vlan-id 100
user@switch# set pvlan400 vlan-id 400

```



**NOTE:** Primary VLANs must always be tagged VLANs, even if they exist on only one device.

3. Configure the primary VLANs to be private:

[edit vlans]

```

user@switch# set pvlan100 pvlan
user@switch# set pvlan400 pvlan

```

4. Configure the PVLAN trunk port to carry the private VLAN traffic between the switches:

[edit vlans]

```

user@switch# set pvlan100 interface xe-0/0/1.0 pvlan-trunk
user@switch# set pvlan400 interface xe-0/0/1.0 pvlan-trunk

```

5. Create secondary VLAN comm300 with VLAN ID 300:

[edit vlans]

```

user@switch# set comm300 vlan-id 300

```

6. Configure the primary VLAN for comm300:

[edit vlans]

```

user@switch# set comm300 primary-vlan pvlan100

```

7. Configure the interface for comm300:

[edit vlans]

```

user@switch# set comm300 interface xe-0/0/3.0

```

8. Create secondary VLAN comm600 with VLAN ID 600:

[edit vlans]

```

user@switch# set comm600 vlan-id 600

```

9. Configure the primary VLAN for comm600:

- ```
[edit vlans]
user@switch# set comm600 primary-vlan pvlan400
```
10. Configure the interface for comm600:
- ```
[edit vlans]
user@switch# set comm600 interface xe-0/0/6.0
```
11. Configure the interswitch isolated VLANs:
- ```
[edit vlans]
user@switch# set pvlan100 pvlan isolation-vlan-id 200
user@switch# set pvlan400 pvlan isolation-vlan-id 500
```



**NOTE:** When you configure a secondary VLAN trunk port to carry an isolated VLAN, you must also configure an *isolation-vlan-id*. This is true even if the isolated VLAN exists only on one switch.

12. Enable trunk port xe-0/0/0 to carry secondary VLANs for the primary VLANs:
- ```
[edit vlans]
user@switch# set pvlan100 interface xe-0/0/0.0 isolated
user@switch# set pvlan400 interface xe-0/0/0.0 isolated
```
13. Configure trunk port xe-0/0/0 to carry comm600 (member of pvlan400):
- ```
[edit vlans]
user@switch# set comm600 interface xe-0/0/0.0
```



**NOTE:** You do not need to explicitly configure xe-0/0/0 to carry the isolated VLAN traffic (tags 200 and 500) because all the isolated ports in pvlan100 and pvlan400—including xe-0/0/0.0—are automatically included in the isolated VLANs created when you configured *isolation-vlan-id 200* and *isolation-vlan-id 500*.

14. Configure xe-0/0/2 and xe-0/0/6 to be isolated:
- ```
[edit vlans]
user@switch# set pvlan100 interface xe-0/0/2.0 isolated
user@switch# set pvlan400 interface xe-0/0/5.0 isolated
```

## Results

Check the results of the configuration on Switch 1:

```
[edit]
user@switch# show
interfaces {
  xe-0/0/0 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members pvlan100;
          members pvlan400;
        }
      }
    }
  }
}
```



```

    }
  }
}
xe-0/0/1 {
  unit 0 {
    family ethernet-switching {
      port-mode trunk;
      vlan {
        members pvlan100;
        members pvlan400;
      }
    }
  }
}
xe-0/0/2 {
  unit 0 {
    family ethernet-switching {
      port-mode access;
    }
  }
}
xe-0/0/3 {
  unit 0 {
    family ethernet-switching {
      port-mode access;
    }
  }
}
xe-0/0/5 {
  unit 0 {
    family ethernet-switching {
      port-mode access;
    }
  }
}
xe-0/0/6 {
  unit 0 {
    family ethernet-switching {
      port-mode trunk;
    }
  }
}
}
vllans {
  comm300 {
    vlan-id 300;
    interface {
      xe-0/0/3.0;
    }
    primary-vlan pvlan100;
  }
  comm600 {
    vlan-id 600;
    interface {
      xe-0/0/6.0;
    }
  }
}

```

```

    }
    primary-vlan pvlan400;
  }
  pvlan100 {
    vlan-id 100;
    interface {
      xe-0/0/0.0;
      xe-0/0/2.0;
      xe-0/0/3.0;
      xe-0/0/1.0 {
        pvlan-trunk;
      }
    }
    no-local-switching;
    isolation-id 200;
  }
  pvlan400 {
    vlan-id 400;
    interface {
      xe-0/0/0.0;
      xe-0/0/5.0;
      xe-0/0/6.0;
      xe-0/0/1.0 {
        pvlan-trunk;
      }
    }
    no-local-switching;
    isolation-id 500;
  }
}

```

## Configuring the PVLANS on Switch 2

The configuration for Switch 2 is almost identical to the configuration for Switch 1. The most significant difference is that xe-0/0/0 on Switch 2 is configured as a promiscuous trunk port or a promiscuous access port, as [Figure 20 on page 281](#) shows. In the following configuration, xe-0/0/0 is configured as a promiscuous access port for primary VLAN pvlan100.

If traffic ingresses on VLAN-enabled port and egresses on a promiscuous access port, the VLAN tags are dropped on egress and the traffic is untagged at that point. For example, traffic for comm600 ingresses on the secondary VLAN trunk port configured on xe-0/0/0.0 on Switch 1 and carries tag 600 as it is forwarded through the secondary VLAN. When it egresses from xe-0/0/0.0 on Switch 2, it will be untagged if you configure xe-0/0/0.0 as a promiscuous access port as shown in this example. If you instead configure xe-0/0/0.0 as a promiscuous trunk port (port-mode trunk), the traffic for comm600 carries its primary VLAN tag (400) when it egresses.

**CLI Quick Configuration** To quickly create and configure the PVLANS on Switch 2, copy the following commands and paste them into a switch terminal window:

```

[edit]
set interfaces xe-0/0/0 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/1 unit 0 family ethernet-switching port-mode trunk

```

```

set interfaces xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan100
set interfaces xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan400
set interfaces xe-0/0/2 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/3 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/5 unit 0 family ethernet-switching port-mode access
set interfaces xe-0/0/6 unit 0 family ethernet-switching port-mode access
set vlans pvlan100 vlan-id 100
set vlans pvlan400 vlan-id 400
set vlans pvlan100 pvlan
set vlans pvlan400 pvlan
set vlans pvlan100 interface xe-0/0/1.0 pvlan-trunk
set vlans pvlan400 interface xe-0/0/1.0 pvlan-trunk
set vlans comm300 vlan-id 300
set vlans comm300 primary-vlan pvlan100
set vlans comm300 interface xe-0/0/3.0
set vlans comm600 vlan-id 600
set vlans comm600 primary-vlan pvlan400
set vlans comm600 interface xe-0/0/6.0
set vlans pvlan100 pvlan isolation-vlan-id 200
set vlans pvlan400 pvlan isolation-vlan-id 500
set vlans pvlan100 interface xe-0/0/0.0 promiscuous
set vlans pvlan100 interface xe-0/0/2.0 isolated
set vlans pvlan400 interface xe-0/0/5.0 isolated

```

#### Step-by-Step Procedure

To configure the private VLANs and secondary VLAN trunk ports:

1. Configure the interfaces and port modes:

[edit interfaces]

```

user@switch# set xe-0/0/0 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/1 unit 0 family ethernet-switching port-mode trunk
user@switch# set xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan100
user@switch# set xe-0/0/1 unit 0 family ethernet-switching vlan members pvlan400
user@switch# set xe-0/0/2 unit 0 family ethernet-switching port-mode trunk
user@switch# set xe-0/0/3 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/5 unit 0 family ethernet-switching port-mode access
user@switch# set xe-0/0/6 unit 0 family ethernet-switching port-mode access

```

2. Create the primary VLANs:

[edit vlans]

```

user@switch# set pvlan100 vlan-id 100
user@switch# set pvlan400 vlan-id 400

```

3. Configure the primary VLANs to be private:

[edit vlans]

```

user@switch# set pvlan100 pvlan
user@switch# set pvlan400 pvlan

```

4. Configure the PVLAN trunk port to carry the private VLAN traffic between the switches:

[edit vlans]

```

user@switch# set pvlan100 interface xe-0/0/1.0 pvlan-trunk
user@switch# set pvlan400 interface xe-0/0/1.0 pvlan-trunk

```

5. Create secondary VLAN comm300 with VLAN ID 300:

[edit vlans]

```

user@switch# set comm300 vlan-id 300

```

6. Configure the primary VLAN for comm300:

[edit vlans]

```

user@switch# set comm300 primary-vlan pvlan100

```

7. Configure the interface for comm300:  

```
[edit vlans]
user@switch# set comm300 interface xe-0/0/3.0
```
8. Create secondary VLAN comm600 with VLAN ID 600:  

```
[edit vlans]
user@switch# set comm600 vlan-id 600
```
9. Configure the primary VLAN for comm600:  

```
[edit vlans]
user@switch# set comm600 primary-vlan pvlan400
```
10. Configure the interface for comm600:  

```
[edit vlans]
user@switch# set comm600 interface xe-0/0/6.0
```
11. Configure the interswitch isolated VLANs:  

```
[edit vlans]
user@switch# set pvlan100 pvlan isolation-vlan-id 200
user@switch# set pvlan400 pvlan isolation-vlan-id 500
```
12. Configure access port xe-0/0/0 to be promiscuous for pvlan100:  

```
[edit vlans]
user@switch# set pvlan100 interface xe-0/0/0.0 promiscuous
```



**NOTE:** A promiscuous access port can be a member of only one primary VLAN.

13. Configure xe-0/0/2 and xe-0/0/6 to be isolated:  

```
[edit vlans]
user@switch# set pvlan100 interface xe-0/0/2.0 isolated
user@switch# set pvlan400 interface xe-0/0/5.0 isolated
```

## Results

Check the results of the configuration on Switch 2:

```
[edit]
user@switch# show
interfaces {
  xe-0/0/0 {
    unit 0 {
      family ethernet-switching {
        port-mode access;
        vlan {
          members pvlan100;
        }
      }
    }
  }
  xe-0/0/1 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
      }
    }
  }
}
```

```

        vlan {
            members pvlan100;
            members pvlan400;
        }
    }
}
xe-0/0/2 {
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
        }
    }
}
xe-0/0/3 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
xe-0/0/5 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
xe-0/0/6 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
vlands {
    comm300 {
        vlan-id 300;
        interface {
            xe-0/0/3.0;
        }
        primary-vlan pvlan100;
    }
    comm600 {
        vlan-id 600;
        interface {
            xe-0/0/6.0;
        }
        primary-vlan pvlan400;
    }
}
pvlan100 {
    vlan-id 100;
    interface {
        xe-0/0/0.0;
        xe-0/0/2.0;
        xe-0/0/3.0;
    }
}

```

```

        xe-0/0/1.0 {
            pvlan-trunk;
        }
    }
    no-local-switching;
    isolation-id 200;
}
pvlan400 {
    vlan-id 400;
    interface {
        xe-0/0/5.0;
        xe-0/0/6.0;
        xe-0/0/1.0 {
            pvlan-trunk;
        }
    }
    no-local-switching;
    isolation-id 500;
}
}

```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying That the Private VLAN and Secondary VLANs Were Created on page 290](#)
- [Verifying The Ethernet Switching Table Entries on page 290](#)

### Verifying That the Private VLAN and Secondary VLANs Were Created

**Purpose** Verify that the primary VLAN and secondary VLANs were properly created on Switch 1.

**Action** Use the `show vlans` command:

```
user@switch> show vlans private-vlan
```

Name	Role	Tag	Interfaces
pvlan100	Primary	100	xe-0/0/0.0, xe-0/0/1.0, xe-0/0/2.0,
xe-0/0/3.0			
__iso_pvlan100__	Isolated	200	xe-0/0/2.0
comm300	Community	300	xe-0/0/3.0
pvlan400	Primary	400	xe-0/0/0.0, xe-0/0/1.0, xe-0/0/5.0,
xe-0/0/6.0			
__iso_pvlan400__	Isolated	500	xe-0/0/5.0
comm600	Community	600	xe-0/0/6.0

**Meaning** The output shows that the private VLANs were created and identifies the interfaces and secondary VLANs associated with them.

### Verifying The Ethernet Switching Table Entries

**Purpose** Verify that the Ethernet switching table entries were created for primary VLAN pvlan100.

**Action** Show the Ethernet switching table entries for pvlan100.

```
user@switch> show ethernet-switching table vlan pvlan100 private-vlan
Ethernet-switching table: 0 unicast entries
pvlan100          *          Flood          - All-members
pvlan100          00:10:94:00:00:02 Learn      - xe-0/0/2.0
__iso_pvlan100__  *          Flood          - All-members
__iso_pvlan100__  00:10:94:00:00:02 Replicated - xe-0/0/2.0
```

- Related Documentation**
- *Understanding Secondary VLAN Trunk Ports and Promiscuous Access Ports on PVLANS*
  - *Understanding Private VLANs*
  - *Understanding PVLAN Traffic Flows Across Multiple Switches*
  - *Creating a Private VLAN on a Single Switch*
  - *Understanding Egress Firewall Filters with PVLANS*

## IRB Interfaces in Private VLANs on MX Series Routers

You can configure integrated routing and bridging (IRB) interfaces in a private VLAN (PVLAN) on a single MX router to span multiple MX routers. PVLANS limit the communication within a VLAN by restricting traffic flows through their member switch ports (which are called “private ports”) so that these ports communicate only with a specified uplink trunk port or with specified ports within the same VLAN. IRB provides simultaneous support for Layer 2 bridging and Layer 3 routing on the same interface. IRB enables you to route packets to another routed interface or to another bridge domain that has an IRB interface configured. You configure a logical routing interface by including the **irb** statement at the **[edit interfaces]** hierarchy level and include that interface in the bridge domain.

PVLANS are supported on MX80 routers, on MX240, MX480, and MX960 routers with DPCs in LAN mode, and on MX Series routers with MPC1, MPC2, and Adaptive Services PICs. This functionality is supported only on MX240, MX480, and MX960 routers that function in enhanced LAN mode (by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level).

IRB in PVLANS replaces the external router used for routing across VLANs. The routing operations in the absence of IRB occur through external router connected to promiscuous port. This behavior takes care of all the routed frames for all the ports defined under the PVLAN domain. In this case, no layer 3 exchange occurs on MX Series routers in enhanced LAN mode for this PVLAN bridge domain. In the case of IRB, the Layer 3 interface is associated with the primary VLAN that is configured and is considered to be a single Layer 3 interface for the entire PVLAN domain. The ingress routed traffic from all ports in the PVLAN domain needs to be mapped to this IRB interface. The egress of the IRB interface take places under the PVLAN. For a PVLAN domain spanning multiple switches, only one IRB interface can be configured in one switch. This IRB interface represent whole PVLAN domain to interact with the Layer 3 domains. An IRB interface only associates with the primary bridge domain and all Layer 3 forwarding occurs only in the primary bridge domain. When a Layer 3 packet is received in an isolated port or a promiscuous port, the device first locates the secondary bridge domain, based on secondary bridge

domain to find primary bridge domain identifier. If the destination MAC address is the local IRB MAC address, the microcode transmits the packet to IRB interface associated with primary bridge domain for further processing. The same procedure occurs for receiver Layer 3 packets in an interswitch link (ISL) port with the isolated or community VLAN tag.

For the ingress Layer 3 packet with Layer 3 forwarding logic sent to IRB interfaces associated with a PVLAN bridge domain, the device processes and determines the ARP entry to send packet to the related interface that might be an isolated port or a community port. The microcode appends or translates the packet VLAN ID to the isolation or community vlan ID based on the port type. The VLAN ID is removed if the related port is untagged. A special operational case exists for Layer 3 packets that are forwarded to remote isolated or community port through the ISL link. The Layer 3 packet might contain the primary bridge domain VLAN ID and the remote node performs the translation or pop operation when it sends the packet out on the related port. This method of processing is different from Layer 2 domains. Because all forwarding base on ARP must be unicast traffic and in the remote node, the port that must be used to forward is known and the transmission of PVLAN ID occurs properly.

An ARP entry carries only the primary bridge domain information. When an ARP response is received from an isolated port or a promiscuous port, the system identifies the secondary bridge domain, and based on the secondary bridge domain, it attempts to retrieve the primary bridge domain identifier. ARP packets eventually reach the IRB interface associated with the primary bridge domain. The kernel considers this ARP packet as a normal bridge domain and creates and maintains the ARP entry only for the primary bridge domain. The same procedure is adopted for ARP request packets that are destined for the local IRB MAC address. The response is transmitted through the IRB interface and appropriate VLAN translation or a pop operation is performed, depending on the received interface.

---

## Guidelines for Configuring IRB Interfaces in PVLANS on MX Series Routers

---

Keep the following points in mind when you configure IRB interfaces for PVLANS:

- All of the IP applications such as IP multicast, IPv4, IPv6, and VRRP that are compatible with IRB in normal bridge domains function properly when IRB for PVLAN bridge domains is configured.
- MC-LAG interfaces are not supported. All ports that are associated with PVLAN bridge domains cannot be mc-ae interfaces.
- IGMP snooping is not supported.
- A virtual switch instance that contains a bridge domain associated with logical interfaces is supported.
- Q-in-Q tunneling is not supported.
- Logical systems are not supported.



- Virtual private LAN service (VPLS) and Ethernet VPN (EVPN) in virtual switch routing instances are not supported. A validation is performed if you attempt to configure Layer 3 interfaces in a secondary VLAN.
- MX Series Virtual Chassis configuration is not supported.

## Forwarding of Packets Using IRB Interfaces in PVLANS

This topic describes how PVLAN packet forwarding operates with IRB interfaces on MX Series routers in enhanced LAN mode. The IRB interface operates as a Layer 3 gateway for all members of a bridging domain. All the members of bridging domain are assumed to be in the same subnet as the subnet of the IRB interface, which works as a gateway.

Consider a sample deployment scenario in which two routers, Router1 and Router2, are configured with a PVLAN. On Router1, the promiscuous port is P1, interswitch link is L1, isolated port is I1, and two community ports are C11 and C21. Similarly, on Router2, the promiscuous port is P2, interswitch link is L2, isolated port is I2, and two community ports are C12 and C22. In the example configuration, the two routers are interconnected through an ISL link, L1 with L2. A PVLAN domain is defined across these two routers encompassing a subdomain of isolated ports (I1, I2), and Community1 ports (C11, C12), and Community2 ports (C21, C22). Because all the ports are in the same subnet, without IRB, switching capability works across ports, across routers following the PVLAN rules. When the end-host needs to reach out cross the subnet, you must configure IRB on the bridging domain. From an end-host perspective, to reach out across the bridging domain, it needs to be configured with the IRB IP address as the default gateway address. All Layer 3 connectivity is established by processing ARP request and ARP responses. The following sections describe the different scenarios encountered for Layer 3 traffic support in PVLANS.

### Incoming ARP Requests on PVLAN Ports

ARP requests enter a PVLAN port as broadcast packets. All packets that enter in the ingress direction of a PVLAN domain contain their bridge domain ID translated into the primary VLAN bridge domain ID. In this case, the bridge domain ID contained in the ARP packet is also translated to the bridge domain ID of the primary VLAN. When IRB is configured in a bridging domain, the IRB MAC address is added to the MAC table as an eligible destination MAC address on the primary VLAN bridge domain ID. The ARP request is flooded to all ports of the secondary bridging domain in which it was received and, in addition, a copy is sent to the IRB logical interface.

When an IRB logical interface receives this packet, it sends the packet to the host as an ARP packet with the primary BD and the Layer 2 logical interface on which it is received. The PVLAN domain learns the source MAC address of the ARP packet and the kernel learns the sender IP of the ARP packet, and triggers a next-hop installation. If the ARP request is destined for IRB IP address, then an ARP response is sent. If proxy ARP is enabled on IRB, IRB responds with an ARP reply if the destination IP address is known.

The preceding configuration case describes a scenario the ARP request came on Local PVLAN port. If the ARP request is received on a remote PVLAN port, then it is flooded on all the ports of the remote PVLAN domain. Because IRB is configured only on one router of the PVLAN domain, on the remote PVLAN, the flooding is on all the ports. As part of

the flooding in the remote PVLAN domain, a copy of the packet is sent to the ISL port. The ISL port processes this packet as though it was received on the local isolated port or community port and the aforementioned method of processing takes place

### Outgoing ARP Responses on PVLAN Ports

When a ARP request is received in the kernel, both the bridge domain ID and the receiving Layer 2 logical interface are transmitted. A next-hop installation is triggered to create a next-hop to the Layer 2 logical interface for the sender IP address with the IRB MAC Address as the destination MAC address and the sender MAC address as the source MAC address, with both these addresses appearing as Layer 2 rewrite during the next-hop. If the ARP request queries for the IRB IP address, then an ARP response is sent to the receiving Layer 2 logical interface. If the ARP request queries for an IP address other than the IRB IP address, it is processed as though proxy ARP is enabled on IRB or it is discarded. Because all ARP requests are processed as being received on the primary VLAN, the response is also sent with the primary VLAN. However, when it reaches the receiving Layer 2 logical interface, the appropriate VLAN translation takes place.

The preceding scenario describes an ARP response being sent on a local PVLAN port. If the ARP request is received from a remote PVLAN domain, the receiving Layer 2 logical interface is the ISL port. In this case, the ARP response is sent to the ISL port, on the remote PVLAN domain, the ARP response received on the ISL port is forwarded to the same port where the ARP request is received. This behavior is possible because the source MAC address of the ARP request is learned on the shared VLAN.

### Outgoing ARP Requests on PVLAN Ports

When IRB has to advertise a ARP request, it uses the kernel flood next-hop for the primary VLAN and floods to all the ports in the local PVLAN domain. The receiving ISL port also floods the packet to the remote PVLAN domain. Although the ARP request is constructed with the primary VLAN, in the egress direction, appropriate VLAN translation or VLAN pop is performed using the specific port.

### Incoming ARP Responses on PVLAN Ports

ARP responses are unicast packets with the destination MAC address as the IRB MAC Address. When such a packet is received on the local PVLAN domain where IRB is enabled, it is forwarded to the IRB logical interface. When the packet arrives at the IRB logical interface, it is propagated to the host. The kernel triggers a next-hop installation with the appropriate Layer 2 rewrite. This operation works properly for ARP responses received on the local PVLAN port. If the ARP response is received on a remote PVLAN port, it is forwarded similar to a normal Layer 2 packet because IRB is not enabled in such a scenario. When the ARP request is sent out from the local PVLAN domain, the receiving ISL port in the remote PVLAN domain might have learned the IRB MAC address on that port, and this address is used to forward the packet to the IRB logical interface.

### Receipt of Layer 3 Packets on PVLAN Ports

The packet is received with the IRB MAC address as the destination MAC address and it is processed through the IRB logical interface. The packet is forwarded in the same manner as a regular IP packet.

## Configuring IRB Interfaces in PVLAN Bridge Domains on MX Series Routers in Enhanced LAN Mode

You can configure integrated routing and bridging (IRB) interfaces in a private VLAN (PVLAN) on a single MX router to span multiple MX routers. PVLANs limit the communication within a VLAN by restricting traffic flows through their member switch ports (which are called “private ports”) so that these ports communicate only with a specified uplink trunk port or with specified ports within the same VLAN. IRB provides simultaneous support for Layer 2 bridging and Layer 3 routing on the same interface. IRB enables you to route packets to another routed interface or to another bridge domain that has an IRB interface configured. You configure a logical routing interface and include that interface in the virtual switch instance that contains the bridge domain. You can specify the secondary VLANs as isolated or community VLANs in the bridge domain.

Before you begin configuring a PVLAN, make sure you have:

- Created and configured the necessary VLANs. See [“Configuring VLAN and Extended VLAN Encapsulation” on page 247](#) and [“Enabling VLAN Tagging” on page 239](#).
- Configured MX240, MX480, and MX960 routers to function in enhanced LAN mode by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level.

You must reboot the router when you configure or delete the enhanced LAN mode on the router. Configuring the **network-services lan** option implies that the system is running in the enhanced IP mode. When you configure a device to function in MX-LAN mode, only the supported configuration statements and operational show commands that are available for enabling or viewing in this mode are displayed in the CLI interface.

If your system contains parameters that are not supported in MX-LAN mode in a configuration file, you cannot commit those unsupported attributes. You must remove the settings that are not supported and then commit the configuration. After the successful CLI commit, a system reboot is required for the attributes to become effective. Similarly, if you remove the **network-services lan** statement, the system does not run in MX-LAN mode. Therefore, all of the settings that are supported outside of the MX-LAN mode are displayed and are available for definition in the CLI interface. If your configuration file contains settings that are supported only in MX-LAN mode, you must remove those attributes before you commit the configuration. After the successful CLI commit, a system reboot is required for the CLI parameters to take effect. The Layer 2 Next-Generation CLI configuration settings are supported in MX-LAN mode. As a result, the typical format of CLI configurations might differ in MX-LAN mode.

To configure an IRB interface in a PVLAN bridge domain associated with a virtual switch instance:

1. Create a promiscuous port for the PVLAN.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode trunk
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

2. Create the interswitch link (ISL) trunk port for the PVLAN.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode trunk inter-switch-link
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

3. Create the isolated port for the PVLAN. The port is identified as an isolated port or a community port, based on the VLAN ID or the list of VLAN IDs to which the interface corresponds. For example, if you configure a port with a VLAN ID of 50, and if you specify a VLAN ID of 50 as the isolated VLAN or tag in the bridge domain, the port is considered as an isolation port.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode access
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

4. Create the community port for the PVLAN. The port is identified as an isolated port or a community port, based on the VLAN ID or the list of VLAN IDs to which the interface corresponds. For example, if you configure a port with a VLAN ID of 50, and if you specify a VLAN ID of 50 as the community VLAN or tag in the bridge domain, the port is considered as a community port.

```
[edit interfaces]
user@host# set interface interface-name unit logical-unit-number family bridge
               interface-mode access
user@host# set interface interface-name unit logical-unit-number family bridge vlan-id
               vlan-id
```

5. Create a virtual switch instance with a bridge domain and associate the logical interfaces.

```
[edit routing-instances]
user@host# set routing-instance-name instance-type virtual-switch
user@host# set routing-instance-name interface interface-name unit
               logical-unit-number
user@host# set routing-instance-name bridge-domains bridge-domain-name
```

6. Create an IRB interface and specify the IRB interface in the bridge domain associated with the virtual switch instance. IRB provides simultaneous support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route local packets to another routed interface or to another bridge domain that has a Layer 3 protocol configured.

```
[edit]
user@host# set interfaces irb unit logical-unit-number family family-name address
               ip-address
[edit routing-instances instance-name bridge-domains bridge-domain-name]
user@host# set routing-interface irb unit logical-unit-number
```

7. Specify the primary, isolated, and community VLAN IDs, and associate the VLANs with the bridge domain.

```
[edit routing-instances instance-name bridge-domains bridge-domain-name]
user@host# set vlan-id vlan-id
```

```
user@host# set isolated-vlan vlan-id
user@host# set community-vlans [ number number-number ]
```

Related •  
Documentation

## Example: Configuring an IRB Interface in a Private VLAN on a Single MX Series Router

For security reasons, it is often useful to restrict the flow of broadcast and unknown unicast traffic and to even limit the communication between known hosts. The private VLAN (PVLAN) feature on MX Series routers allows an administrator to split a broadcast domain into multiple isolated broadcast subdomains, essentially putting a VLAN inside a VLAN.

This example describes how to create an integrated routing and bridging (IRB) interface in a PVLAN bridge domain associated with a virtual switch instance on a single MX Series router:



**NOTE:** Configuring a voice over IP (VoIP) VLAN on PVLAN interfaces is not supported.

- [Requirements on page 297](#)
- [Overview and Topology on page 297](#)
- [Configuration on page 298](#)
- [Verification on page 302](#)

## Requirements

This example uses the following hardware and software components:

- One MX Series router in enhanced LAN mode.
- Junos OS Release 15.1 or later for MX Series routers

Before you begin configuring a PVLAN, make sure you have:

- Created and configured the necessary VLANs. See [“Configuring VLAN and Extended VLAN Encapsulation” on page 247](#) and [“Enabling VLAN Tagging” on page 239](#).
- Configured MX240, MX480, and MX960 routers to function in enhanced LAN mode by entering the **network-services lan** statement at the **[edit chassis]** hierarchy level.

## Overview and Topology

In a large office with multiple buildings and VLANs, you might need to isolate some workgroups or other endpoints for security reasons or to partition the broadcast domain. This configuration example shows a simple topology to illustrate how to create a PVLAN with one primary VLAN and four community VLANs, as well as two isolated ports.

Assume a sample deployment in which a primary VLAN named VP contains ports, p1, p2, t1, t2, i1, i2, cx1, and cx2. The port types of these configured ports are as follows:

- Promiscuous ports = p1, p2
- ISL ports = t1, t2
- Isolated ports = i1, i2
- Community VLAN = Cx
- Community ports = cx1, cx2

An IRB interface, irb.0, is configured and mapped to the bridge domain in the virtual switch instance.

Bridge domains are provisioned for each of the VLANs, namely, Vp, Vi, and Vcx. Assume the bridge domains to be configured as follows:

Vp—BD\_primary\_Vp (ports contained are p1, t1, i1, i2, cx1, cx2)

Vi—BD\_isolate\_Vi (ports contained are p1, t1, \*i1, \*i2)

Vcx—BD\_community\_Vcx (ports contained are p1, t1, cx1, cx2)

The bridge domains for community, primary, and isolated VLANs are automatically created by the system internally when you configure a bridge domain with a trunk interface, access interface, or interswitch link. The bridge domains contain the same VLAN ID corresponding to the VLANs. To use bridge domains for PVLANS, you must configure the following additional attributes:

## Configuration

To configure an IRB interface in a PVLAN, perform these tasks:

### CLI Quick Configuration

To quickly create and configure a PVLAN and include an IRB interface in a PVLAN bridge domain associated with a virtual switch instance, copy the following commands and paste them into the router terminal window:

#### Configuring an IRB Interface

```
set interfaces irb unit 0 family inet address 22.22.22.1/24
```

#### Configuring Promiscuous, ISL, Isolated, and Community Ports

```
set interfaces ge-0/0/9 unit 0 family bridge interface-mode trunk
set interfaces ge-0/0/9 unit 0 family bridge vlan-id 100
set interfaces ge-0/0/13 unit 0 family bridge interface-mode trunk
set interfaces ge-0/0/13 unit 0 family bridge vlan-id 100
set interfaces ge-0/0/10 unit 0 family bridge interface-mode access
set interfaces ge-0/0/10 unit 0 family bridge vlan-id 10
set interfaces ge-0/0/12 unit 0 family bridge interface-mode access
set interfaces ge-0/0/12 unit 0 family bridge vlan-id 10
set interfaces ge-0/0/1 unit 0 family bridge interface-mode access
set interfaces ge-0/0/1 unit 0 family bridge vlan-id 50
set interfaces ge-0/0/2 unit 0 family bridge interface-mode access
set interfaces ge-0/0/2 unit 0 family bridge vlan-id 50
set interfaces ge-0/0/3 unit 0 family bridge interface-mode access
set interfaces ge-0/0/3 unit 0 family bridge vlan-id 60
set interfaces ge-0/0/4 unit 0 family bridge interface-mode access
```

	<pre>set interfaces ge-0/0/4 unit 0 family bridge vlan-id 60</pre>
Configuring a Virtual Switch Instance With Bridge Domain Interfaces	<pre>set routing-instances vs-1 instance-type virtual-switch set routing-instances vs-1 interface ge-0/0/1.0 set routing-instances vs-1 interface ge-0/0/2.0 set routing-instances vs-1 interface ge-0/0/3.0 set routing-instances vs-1 interface ge-0/0/4.0 set routing-instances vs-1 interface ge-0/0/9.0 set routing-instances vs-1 interface ge-0/0/10.0 set routing-instances vs-1 interface ge-0/0/12.0 set routing-instances vs-1 interface ge-0/0/13.0 set routing-instances vs-1 bridge-domains bd1</pre>
Specify the IRB Interface and Primary, Isolated, and Community VLAN IDs in the Bridge Domain	<pre>set routing-instances vs1 bridge-domains bd1 vlan-id 100 set routing-instances vs1 bridge-domains bd1 isolated-vlan 10 set routing-instances vs1 bridge-domains bd1 community-vlans [50 60] set routing-instances vs1 bridge-domains bd1 routing-interface irb.0</pre>
Step-by-Step Procedure	<p>To configure the interswitch link (ISL) for a PVLAN, the PVLAN port types, and secondary VLANs for the PVLAN:</p> <ol style="list-style-type: none"> <li>1. Create an IRB interface. <pre>[edit interfaces] user@host# set interfaces irb unit 0 family inet address 22.22.22.1/24</pre> </li> <li>2. Create a promiscuous port for the PVLAN. <pre>[edit interfaces] user@host# set ge-0/0/9 unit 0 family bridge interface-mode trunk user@host# set ge-0/0/9 unit 0 family bridge vlan-id 100</pre> </li> <li>3. Create the interswitch link (ISL) trunk port for the PVLAN. <pre>[edit interfaces] user@host# set ge-0/0/13 unit 0 family bridge interface-mode trunk inter-switch-link user@host# set ge-0/0/13 unit 0 family bridge vlan-id 100</pre> </li> <li>4. Create the isolated ports for the PVLAN. <pre>[edit interfaces] user@host# set ge-0/0/10 unit 0 family bridge interface-mode access user@host# set ge-0/0/10 unit 0 family bridge vlan-id 10 user@host# set ge-0/0/12 unit 0 family bridge interface-mode access user@host# set ge-0/0/12 unit 0 family bridge vlan-id 10</pre> </li> <li>5. Create the community ports for the PVLAN. <pre>[edit interfaces] user@host# set ge-0/0/1 unit 0 family bridge interface-mode access user@host# set ge-0/0/1 unit 0 family bridge vlan-id 50 user@host# set ge-0/0/2 unit 0 family bridge interface-mode access user@host# set ge-0/0/2 unit 0 family bridge vlan-id 50 user@host# set ge-0/0/3 unit 0 family bridge interface-mode access user@host# set ge-0/0/3 unit 0 family bridge vlan-id 60 user@host# set ge-0/0/4 unit 0 family bridge interface-mode access user@host# set ge-0/0/4 unit 0 family bridge vlan-id 60</pre> </li> </ol>

6. Create a virtual switch instance with a bridge domain and associate the logical interfaces.

```
[edit routing-instances]
user@host# set vs-1 instance-type virtual-switch
user@host# set vs-1 interface ge-0/0/1.0
user@host# set vs-1 interface ge-0/0/2.0
user@host# set vs-1 interface ge-0/0/3.0
user@host# set vs-1 interface ge-0/0/4.0
user@host# set vs-1 interface ge-0/0/9.0
user@host# set vs-1 interface ge-0/0/10.0
user@host# set vs-1 interface ge-0/0/12.0
user@host# set vs-1 interface ge-0/0/13.0
user@host# set vs-1 bridge-domains bd1
```

7. Specify the IRB interface, primary, isolated, and community VLAN IDs, and associate the VLANs with the bridge domain.

```
[edit routing-instances vs1 bridge-domains bd1]
user@host# set vlan-id 100
user@host# set isolated-vlan 10
user@host# set community-vlans [50 60]
user@host# set routing-interface irb.0
```

## Results

Check the results of the configuration:

```
[edit]
[interfaces]
  ge-0/0/9 {
    unit 0 {
      family bridge {
        interface-mode trunk;
        vlan-id 100;          Promiscuous port by vlan id
      }
    }
  }

  ge-0/0/13 {
    unit 0 {
      family bridge {
        interface-mode trunk inter-switch-link;  ISL trunk
        vlan-id 100;
      }
    }
  }

  ge-0/0/10 {
    unit 0 {
      family bridge {
        interface-mode access;
        vlan-id 10;          isolated port by vlan ID
      }
    }
  }

  ge-0/0/12 {
```



```

        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 10;          isolated port by vlan ID
            }
        }
    }
    ge-0/0/1 {
        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 50;          community port by vlan ID
            }
        }
    }
    ge-0/0/2 {
        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 50;          community port by vlan ID
            }
        }
    }
    ge-0/0/3 {
        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 60;          community port by vlan ID
            }
        }
    }
    ge-0/0/4 {
        unit 0 {
            family bridge {
                interface-mode access;
                vlan-id 60;          community port by vlan ID
            }
        }
    }
    irb {
        unit 0 {
            family inet {
                address 22.22.22.1/24;
            }
        }
    }
}

[edit]
routing-instances {
    vs-1 {
        instance-type virtual-switch;
        interface ge-0/0/1.0;
        interface ge-0/0/2.0;
        interface ge-0/0/3.0;
        interface ge-0/0/4.0;
        interface ge-0/0/9.0;
    }
}

```

```

interface ge-0/0/10.0;
interface ge-0/0/12.0;
interface ge-0/0/13.0;

bridge-domains {
  bd1 {
    vlan-id 100;           /* primary vlan */
    isolated-vlan 10;
    community-vlans [50 60]
    routing-interface irb.0 /* IRB interface */
  }
}

```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- [Verifying That the Private VLAN and Secondary VLANs Were Created on page 302](#)

### Verifying That the Private VLAN and Secondary VLANs Were Created

**Purpose** Verify that the primary VLAN and secondary VLANs were properly created on the switch.

**Action** Use the `show bridge domain` command:

```

user@host> show bridge domain
Routing instance      Bridge domain      VLAN ID      Interfaces
default-switch        bd1-primary-100    100          ge-0/0/9.0
                    ge-0/0/10.0
                    ge-0/0/12.0
                    ge-0/0/13.0
                    ge-0/0/1.0
                    ge-0/0/2.0
                    ge-0/0/3.0

                    ge-0/0/4.0
default-switch        bd1-isolation-10   10          ge-0/0/9.0
                    ge-0/0/10.0
                    ge-0/0/12.0
                    ge-0/0/13.0

default-switch        bd1-comunity-50    50          ge-0/0/9.0
                    ge-0/0/13.0
                    ge-0/0/1.0
                    ge-0/0/2.0

default-switch        bd1-comunity-60    60          ge-0/0/9.0
                    ge-0/0/13.0
                    ge-0/0/3.0
                    ge-0/0/4.0

```

**Meaning** The output shows that the primary VLAN was created and identifies the interfaces and secondary VLANs associated with it.

Related •  
Documentation



# Configuring Layer 2 Bridging Interfaces

- [Layer 2 Bridging Interfaces Overview on page 305](#)
- [Configuring Layer 2 Bridging Interfaces on page 306](#)
- [Example: Configuring the MAC Address of an IRB Interface on page 306](#)

## Layer 2 Bridging Interfaces Overview

---

Bridging operates at Layer 2 of the OSI reference model while routing operates at Layer 3. A set of logical ports configured for bridging can be said to constitute a bridging domain.

A bridging domain can be created by configuring a routing instance and specifying the instance-type as **bridge**.

Integrated routing and bridging (IRB) is the ability to:

- Route a packet if the destination MAC address is the MAC address of the router and the packet **ethertype** is IPv4, IPv6, or MPLS.
- Switch all multicast and broadcast packets within a bridging domain at layer 2.
- Route a copy of the packet if the destination MAC address is a multicast address and the **ethertype** is IPv4 or IPv6.
- Switch all other unicast packets at Layer 2.
- Handle supported Layer 2 control packets such as STP and LACP.
- Handle supported Layer 3 control packets such as OSPF and RIP.

### Related Documentation

- [Configuring Layer 2 Bridging Interfaces on page 306](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Layer 2 Bridging Interfaces

Integrated routing and bridging interfaces are logical Layer 3 VLAN interfaces that route traffic between bridge domains (VLANs). So, an IRB logical interface is usually associated with a bridge domain or VLAN. The IRB logical interface also functions as the gateway IP address for the other devices on the same sub-network that are associated with the same VLAN. IRB interfaces support Layer 2 bridging and Layer 3 routing on the same interface. As a result, IRB interfaces enable the router to act both as a router and as a Layer 2 switch at the same time.



**NOTE:** If the status of all Layer 2 logical interfaces in the bridge domain is down, the status of the irb logical interface is also down.

To configure an IRB logical interface:

1. In configuration mode, at the **[edit bridge-domains]** hierarchy level, configure the bridge domain by specifying the name of the bridge and the VLAN ID.

```
[edit bridge-domains]
user@host# set bridge-domain-name vlan-id vlan-id
```

2. Configure an interface in trunk mode and include the interface in the appropriate bridge domain using the **vlan-id-list** command at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
user@host# set interfacetype-fpc/pic/port vlan-tagging
user@host# set interfacetype-fpc/pic/port unit logical-unit-number family bridge
interface-mode trunk
user@host# set interfacetype-fpc/pic/port unit logical-unit-number family bridge
vlan-id-list vlan-id
```

3. Configure the IRB interface at the **[edit interfaces]** hierarchy level and specify the associated IP address.

```
[edit interfaces]
user@host# set interfaces irb unit logical-unit-number family inet address address
```

4. Configure the IRB interface as the routing interface for the bridge domain at the **[edit bridge-domains]** hierarchy level.

```
[edit bridge-domains]
user@host# set bridge-domain-name vlan-id vlan-id routing-interface
irb.logical-interface-number
```

### Related Documentation

- [Layer 2 Bridging Interfaces Overview on page 305](#)
- [Example: Configuring the MAC Address of an IRB Interface on page 306](#)

## Example: Configuring the MAC Address of an IRB Interface

This example shows how to configure the media access control (MAC) address of an integrated routing and bridging (IRB) interface for devices with Modular Port Concentrator

(MPC) cards. An IRB interface is a Layer 3 routing interface that is used in a bridge domain or virtual private LAN service (VPLS) routing.

- [Requirements on page 307](#)
- [Overview on page 307](#)
- [Configuration on page 308](#)
- [Verification on page 312](#)

## Requirements

This example requires the following hardware and software components:

- MX Series routers with MPC cards.
- Junos OS Release 13.2 or later running on all devices.

## Overview

Junos OS Release 13.2 and later support the assignment of MAC addresses to IRB logical interfaces. The IRB logical interfaces provide support for simultaneous Layer 2 bridging and Layer 3 routing within the same bridge domain. Packets that arrive on an interface of the bridge domain are either switched or routed, based on the destination MAC address of the packet. The packets with the router's Layer 2 virtual MAC address, which is manually configured, are switched to Layer 2 interfaces.

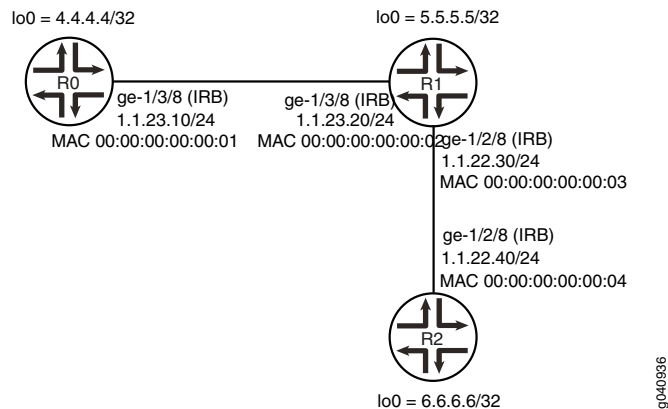
Configuring a MAC address of an IRB logical interface allows the use of a transparent firewall between two VLANs on the same switch. When both VLANs are on the same subnet and traffic from one VLAN needs to go through the firewall to the host on the other VLAN, then the VLAN tag is changed to communicate with the host on the other VLAN.

Before the introduction of this feature, if the MAC address of an IRB logical interface was the same for both VLANs, the firewall dropped the traffic. This new feature allows you to configure distinct MAC addresses for different VLANs, which facilitates the exchange of traffic between two VLANs on the same switch.

In case of VPLS multihoming, if there is a failover of the primary provider edge (PE) router to a secondary PE router, the MAC address of an IRB changes. The hosts connected to the customer edge (CE) router must change their Address Resolution Protocol (ARP) for IRB's IP and MAC address. This feature allows you to configure the same MAC address for IRB interfaces in both the primary and secondary PE routers and eliminates the need for changing the ARP binding of the IRB logical interface in CE routers, in case of a failover.

[Figure 21 on page 308](#) shows the sample topology.

Figure 21: Configuring the MAC Address of an IRB Interface



In this example you configure MAC address of IRB logical interfaces.

## Configuration

**CLI Quick Configuration** To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
Router R0
set interfaces ge-1/3/8 vlan-tagging
set interfaces ge-1/3/8 encapsulation flexible-ethernet-services
set interfaces ge-1/3/8 unit 10 encapsulation vlan-bridge
set interfaces ge-1/3/8 unit 10 vlan-id 10
set interfaces irb unit 10 family inet address 1.1.23.1/24
set interfaces irb unit 10 family mpls
set interfaces irb unit 10 mac 00:00:00:00:00:01
set interfaces lo0 unit 10 family inet address 4.4.4.4/32
set protocols rsvp interface irb.10
set protocols mpls label-switched-path R0-1-R2 to 6.6.6.6
set protocols mpls label-switched-path R0-1-R2 install 6.6.6.6/32 active
set protocols mpls label-switched-path R0-1-R2 no-cspf
set protocols mpls interface irb.10
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 4.4.4.4
set protocols bgp group ibgp neighbor 6.6.6.6
set protocols ospf area 0.0.0.0 interface irb.10
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ldp interface irb.10
set protocols ldp interface lo0.10
set routing-options autonomous-system 400
set bridge-domains lsbd1 vlan-id 10
set bridge-domains lsbd1 interface ge-1/3/8.10
```



```
set bridge-domains lsbd1 routing-interface irb.10
```

```
Router R1  set interfaces ge-1/3/8 vlan-tagging
            set interfaces ge-1/3/8 encapsulation flexible-ethernet-services
            set interfaces ge-1/3/8 unit 10 encapsulation vlan-bridge
            set interfaces ge-1/3/8 unit 10 vlan-id 10
            set interfaces ge-1/2/8 vlan-tagging
            set interfaces ge-1/2/8 encapsulation flexible-ethernet-services
            set interfaces ge-1/2/8 unit 40 encapsulation vlan-bridge
            set interfaces ge-1/2/8 unit 40 vlan-id 40
            set interfaces irb unit 20 family inet address 1.1.23.2/24
            set interfaces irb unit 20 family mpls
            set interfaces irb unit 20 mac 00:00:00:00:00:02
            set interfaces irb unit 30 family inet address 1.1.22.2/24
            set interfaces irb unit 30 family mpls
            set interfaces irb unit 30 mac 00:00:00:00:00:03
            set interfaces lo0 unit 20 family inet address 5.5.5.5/32
            set protocols rsvp interface irb.20
            set protocols rsvp interface irb.30
            set protocols mpls interface irb.30
            set protocols mpls interface irb.20
            set protocols ospf area 0.0.0.0 interface irb.20
            set protocols ospf area 0.0.0.0 interface irb.30
            set protocols ospf area 0.0.0.0 interface lo0.20 passive
            set protocols ldp interface irb.20
            set protocols ldp interface irb.30
            set protocols ldp interface lo0.20
            set routing-options autonomous-system 400
            set bridge-domains lsbd2 vlan-id 10
            set bridge-domains lsbd2 interface ge-1/3/8.10
            set bridge-domains lsbd2 routing-interface irb.20
            set bridge-domains lsbd3 vlan-id 40
            set bridge-domains lsbd3 interface ge-1/2/8.40
            set bridge-domains lsbd3 routing-interface irb.30
```

```
Router R2  set interfaces ge-1/2/8 vlan-tagging
            set interfaces ge-1/2/8 encapsulation flexible-ethernet-services
            set interfaces ge-1/2/8 unit 40 encapsulation vlan-bridge
            set interfaces ge-1/2/8 unit 40 vlan-id 40
            set interfaces irb unit 40 family inet address 1.1.22.1/24
            set interfaces irb unit 40 family mpls
            set interfaces irb unit 40 mac 00:00:00:00:00:04
            set interfaces lo0 unit 30 family inet address 6.6.6.6/32
            set protocols rsvp interface irb.40
            set protocols mpls label-switched-path R2-1-R0 to 4.4.4.4
            set protocols mpls label-switched-path R2-1-R0 no-cspf
            set protocols mpls interface irb.40
            set protocols bgp group ibgp type internal
            set protocols bgp group ibgp local-address 6.6.6.6
            set protocols bgp group ibgp neighbor 4.4.4.4
            set protocols ospf area 0.0.0.0 interface irb.40
            set protocols ospf area 0.0.0.0 interface lo0.30 passive
            set protocols ldp interface irb.40
            set protocols ldp interface lo0.30
            set routing-options autonomous-system 400
```

```

set bridge-domains lsbd4 vlan-id 40
set bridge-domains lsbd4 interface ge-1/2/8.40
set bridge-domains lsbd4 routing-interface irb.40

```

### Configuring the MAC Address of an IRB Interface

#### Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.



**NOTE:** Repeat this procedure for Juniper Networks Routers R1 and R2, modifying the appropriate interface names, addresses, and any other parameters for each router.

To configure the MAC address of an IRB interface on Router R0:

1. Configure the physical interfaces.

```

[edit interfaces ge-1/3/8]
user@R0# set vlan-tagging
user@R0# set encapsulation flexible-ethernet-services
user@R0# set unit 10 encapsulation vlan-bridge
user@R0# set unit 10 vlan-id 10

```

2. Configure the IRB logical interface.

```

[edit interfaces irb]
user@R0# set unit 10 family inet address 1.1.23.1/24
user@R0# set unit 10 family mpls
user@R0# set unit 10 mac 00:00:00:00:00:01

[edit interfaces]
user@R0# set lo0 unit 10 family inet address 4.4.4.4/32

```

3. Configure the RSVP protocol.

```

[edit protocols rsvp]
user@R0# set interface irb.10

```

4. Configure the MPLS protocol.

```

[edit protocols mpls]
user@R0# set label-switched-path R0-1-R2 to 6.6.6.6
user@R0# set label-switched-path R0-1-R2 install 6.6.6.6/32 active
user@R0# set label-switched-path R0-1-R2 no-cspf
user@R0# set interface irb.10
user@R0# set interface irb.10

```

5. Configure the BGP protocol.

```

[edit protocols BGP]
user@R0# set group ibgp type internal
user@R0# set group ibgp local-address 4.4.4.4
user@R0# set group ibgp neighbor 6.6.6.6

```

6. Configure the OSPF protocol.

```
[edit protocols ospf]
user@R0# set area 0.0.0.0 interface irb.10
user@R0# set area 0.0.0.0 interface lo0.10 passive
```

7. Configure the LDP protocol.

```
[edit protocols ldp]
user@R0# set interface irb.10
user@R0# set interface lo0.10
```

8. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R0# set autonomous-system 400
```

9. Configure the bridge domains.

```
[edit]
user@R0# set bridge-domains lsbd1 vlan-id 10
user@R0# set bridge-domains lsbd1 interface ge-1/3/8.10
user@R0# set bridge-domains lsbd1 routing-interface irb.10
```

## Results

From configuration mode, enter the **show interfaces**, **show protocols** and **show bridge-domains**, commands and confirm your configuration. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
ge-1/3/8 {
  unit 10 {
    encapsulation vlan-bridge;
    vlan-id 10;
  }
}
irb {
  unit 10 {
    family inet {
      mtu 1450;
      address 1.1.1.1/24;
      address 1.1.23.1/24;
    }
    family mpls;
    mac 00:00:00:00:00:01;
  }
}
lo0 {
  unit 10 {
    family inet {
      address 4.4.4.4/32;
    }
  }
}
user@R0# show protocols
```

```
rsvp {
  interface irb.10;
}
mpls {
  label-switched-path R0-1-R2 {
    to 6.6.6.6;
    install 6.6.6.6/32 active;
    no-cspf;
  }
  interface irb.10;
}
bgp {
  group ibgp {
    type internal;
    local-address 4.4.4.4;
    neighbor 6.6.6.6;
  }
}
ospf {
  area 0.0.0.0 {
    interface irb.10;
    interface lo0.10 {
      passive;
    }
  }
}
ldp {
  interface irb.10;
  interface lo0.10;
}
user@R0# show bridge-domains
lsbd1 {
  vlan-id 10;
  interface ge-1/3/8.10;
  routing-interface irb.10;
}
```

If you are done configuring the devices, commit the configuration.

```
user@host# commit
```

## Verification

Confirm that the configuration is working properly.

- [Verifying the MAC Address of the IRB Interface on page 312](#)

---

### Verifying the MAC Address of the IRB Interface

**Purpose** Verify that the specified MAC address is assigned to the IRB interface.

**Action** From operational mode, run the **show interfaces irb** command on the device.

```
user@host# show interfaces irb
```

```
Physical interface: irb, Enabled, Physical link is Up
Interface index: 132, SNMP ifIndex: 505
Type: Ethernet, Link-level type: Ethernet, MTU: 1514
Device flags : Present Running
Interface flags: SNMP-Traps
Link type : Full-Duplex
Link flags : None
Current address: 80:71:1f:c2:58:f0, Hardware address: 80:71:1f:c2:58:f0
Last flapped : Never
Input packets : 0
Output packets: 0
```

```
Logical interface irb.10 (Index 326) (SNMP ifIndex 634)
Flags: SNMP-Traps 0x0 Encapsulation: ENET2
MAC: 00:00:00:00:00:01
Bandwidth: 1000mbps
Routing Instance: LS1/default Bridging Domain: lsbd1+10
Input packets : 55202
Output packets: 69286
Protocol inet, MTU: 1450
  Flags: Sendbcst-pkt-to-re, Is-Primary, User-MTU
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255
  Addresses, Flags: Is-Preferred
    Destination: 1.1.23/24, Local: 1.1.23.1, Broadcast: 1.1.23.255
Protocol mpls, MTU: 1500, Maximum labels: 3
  Flags: Is-Primary
Protocol multiservice, MTU: 1500
```

```
Logical interface irb.20 (Index 358) (SNMP ifIndex 635)
Flags: SNMP-Traps 0x0 Encapsulation: ENET2
MAC: 00:00:00:00:00:02
Bandwidth: 1000mbps
Routing Instance: LS2/default Bridging Domain: lsbd2+10
Input packets : 66044
Output packets: 68464
Protocol inet, MTU: 1450
  Flags: Sendbcst-pkt-to-re, Is-Primary, User-MTU
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 1.1.1/24, Local: 1.1.1.2, Broadcast: 1.1.1.255
  Addresses, Flags: Is-Preferred
    Destination: 1.1.23/24, Local: 1.1.23.2, Broadcast: 1.1.23.255
Protocol mpls, MTU: 1500, Maximum labels: 3
  Flags: Is-Primary
Protocol multiservice, MTU: 1500
```

```
Logical interface irb.30 (Index 360) (SNMP ifIndex 636)
Flags: SNMP-Traps 0x0 Encapsulation: ENET2
MAC: 00:00:00:00:00:03
Bandwidth: 1000mbps
Routing Instance: LS2/default Bridging Domain: lsbd3+40
Input packets : 26948
Output packets: 53605
Protocol inet, MTU: 1500
  Flags: Sendbcst-pkt-to-re
  Addresses, Flags: Is-Preferred Is-Primary
```

```

    Destination: 1.1.22/24, Local: 1.1.22.2, Broadcast: 1.1.22.255
    Addresses, Flags: Is-Preferred
    Destination: 2.2.2/24, Local: 2.2.2.1, Broadcast: 2.2.2.255
    Protocol mpls, MTU: 1500, Maximum labels: 3
    Protocol multiservice, MTU: 1500

```

```

Logical interface irb.40 (Index 355) (SNMP ifIndex 632)
Flags: SNMP-Traps 0x0 Encapsulation: ENET2
MAC: 00:00:00:00:00:04
Bandwidth: 1000mbps
Routing Instance: LS3/default Bridging Domain: lsbd4+40
Input packets : 40575
Output packets: 31128
Protocol inet, MTU: 1500
  Flags: Sendbcst-pkt-to-re, Is-Primary
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 1.1.22/24, Local: 1.1.22.1, Broadcast: 1.1.22.255
  Protocol mpls, MTU: 1500, Maximum labels: 3
  Flags: Is-Primary
  Protocol multiservice, MTU: 1500

```

**Meaning** The output shows the manually configured MAC address in the MAC field.



**NOTE:** If you did not configure the MAC address for a logical interface, the output does not include this value. However, the device uses the MAC address of the physical interface during data transmission.

- Related Documentation**
- [mac on page 1045](#)
  - *Active-Active Bridging and VRRP over IRB Functionality Overview*

# Configuring Link Layer Discovery Protocol

- [LLDP Overview on page 315](#)
- [Configuring LLDP on page 316](#)
- [Example: Configuring LLDP on page 319](#)
- [Tracing LLDP Operations on page 320](#)

## LLDP Overview

---

The Link Layer Discovery Protocol (LLDP) is an industry-standard, vendor-neutral method to allow networked devices to advertise capabilities, identity, and other information onto a LAN. The Layer 2 protocol, detailed in IEEE 802.1AB-2005, replaces several proprietary protocols implemented by individual vendors for their equipment.

LLDP allows network devices that operate at the lower layers of a protocol stack (such as Layer 2 bridges and switches) to learn some of the capabilities and characteristics of LAN devices available to higher layer protocols, such as IP addresses. The information gathered through LLDP operation is stored in a network device and is queried with SNMP. Topology information can also be gathered from this database.

Some of the information that can be gathered by LLDP (only minimal information is mandatory) is:

- System name and description
- Port name and description
- VLAN name and identifier
- IP network management address
- Capabilities of the device (for example, switch, router, or server)
- MAC address and physical layer information
- Power information
- Link aggregation information



**NOTE:** LLDP media endpoint discovery (LLDP-MED) is not supported on T Series routers.

LLDP frames are sent at fixed intervals on each port that runs LLDP. LLDP protocol data units (LLDP PDUs) are sent inside Ethernet frames and identified by their destination Media Access Control (MAC) address (**01:80:C2:00:00:0E**) and Ethertype (**0x88CC**). Mandatory information supplied by LLDP is chassis ID, port ID, and a time-to-live value for this information.

LLDP is a powerful way to allow Layer 2 devices to gather details about other network-attached devices.

- Related Documentation**
- [Configuring LLDP on page 316](#)
  - [Tracing LLDP Operations on page 320](#)
  - [Example: Configuring LLDP on page 319](#)

---

## Configuring LLDP

You configure LLDP by including the **lldp** statement and associated parameters at the **[edit protocols]** hierarchy level. The complete set of LLDP statements follows:

```
lldp {  
  advertisement-interval seconds;  
  disable;  
  hold-multiplier number;  
  interface (all | interface-name) {  
    disable;  
  }  
  lldp-configuration-notification-interval seconds;  
  management-address ip-management-address;;  
  port-description-type {  
    interface-alias;  
    interface-description;  
  }  
  port-id-subtype {  
    interface-name;  
    locally-assigned;  
  }  
  ptopo-configuration-maximum-hold-time seconds;  
  ptopo-configuration-trap-interval seconds;  
  traceoptions {  
    file filename <files number> <size size> <world-readable | no-world-readable>;  
    flag flag <flag-modifier> <disable>;  
  }  
  transmit-delay seconds  
}
```

The following statements have default values:

- **advertisement-interval**—The default value is 30 seconds. The allowable range is from 5 through 32768 seconds.
- **hold-multiplier**—The default values is 4. The allowable range is from 2 through 10.



- **ptopo-configuration-maximum-hold-time**—The default value is 300 seconds. The allowable range is from 1 through 2147483647 seconds.
- **transmit-delay**—The default value is 2 seconds. The allowable range is from 1 through 8192 seconds.

The following statements must be explicitly configured:

- **lldp-configuration-notification-interval**—The allowable range is from 0 through 3600 seconds. There is no default value.
- **ptopo-configuration-trap-interval**—The allowable range is from 1 through 2147483647 seconds. There is no default value.

LLDP is enabled on all interfaces by default. If it is disabled, you can enable LLDP by configuring it on all interfaces or on specific interfaces.



**NOTE:** The *interface-name* must be the physical interface (for example, *ge-1/0/0*) and not a logical interface (unit).

- To configure LLDP on all interfaces:

```
[edit protocols lldp]
user@switch# set interface all
```

- To configure LLDP on a specific interface:

```
[edit protocols lldp]
user@switch# set interface interface-name
```

To disable LLDP, include the **disable** option:

- To disable LLDP on all interfaces:

```
[edit protocols lldp]
user@switch# set interface all disable
```

- To disable LLDP on a specific interface:

```
[edit protocols lldp]
user@switch# set interface interface-name disable
```

Starting with Junos OS Release 14.2, you can configure management interfaces, such as *fxp0* or *me0*, on MX Series routers to send LLDP frames to and receive LLDP frames from neighboring LLDP interfaces by including the **interface *interface-name*** statement at the **[edit protocols lldp]** and **[edit routing-instances *routing-instance-name* protocols lldp]** hierarchy levels. By default, the functionality to send LLDP frames is enabled. You can also specify a management interface with the **show lldp neighbors interface *interface-name*** command to view configuration details about LLDP neighbors for the corresponding management interface.

To configure LLDP on a T Series router within a TX Matrix, you must specify the interface name in the LLDP configuration for the TX Matrix. For information about interface names for TX Matrix routers, see *TX Matrix Router Chassis and Interface Names*. For information about FPC numbering, see *Routing Matrix with a TX Matrix Router FPC Numbering*.

LLDP is supported on extended ports in the Junos Fusion technology. For information about interface names in the Junos Fusion technology, see *Understanding Junos Fusion Ports*.

The advertisement interval determines the frequency that an LLDP interface sends LLDP advertisement frames. The default value is 30 seconds. The allowable range is from 5 through 32768 seconds. You adjust this parameter by including the **advertisement-interval** statement at the **[edit protocols lldp]** hierarchy level.

The hold multiplier determines the multiplier to apply to the advertisement interval. The resulting value in seconds is used to cache learned LLDP information before discard. The default value is 4. When used with the default advertisement interval value of 30 seconds, this makes the default cache lifetime 120 seconds. The allowable range of the hold multiplier is from 2 through 10. You adjust this parameter by including the **hold-multiplier** statement at the **[edit protocols lldp]** hierarchy level.

The transmit delay determines the delay between any two consecutive LLDP advertisement frames. The default value is 2 seconds. The allowable range is from 1 through 8192 seconds. You adjust this parameter by including the **transmit-delay** statement at the **[edit protocols lldp]** hierarchy level.

The physical topology configuration maximum hold time determines the time interval for which an agent device maintains physical topology database entries. The default value is 300 seconds. The allowable range is from 1 through 2147483647 seconds. You adjust this parameter by including the **ptopo-configuration-maximum-hold-time** statement at the **[edit protocols lldp]** hierarchy level.

The LLDP configuration notification interval determines the period for which trap notifications are sent to the SNMP Master Agent when changes occur in the database of LLDP information. This capability is disabled by default. The allowable range is from 0 (disabled) through 3600 seconds. You adjust this parameter by including the **lldp-configuration-notification-interval** statement at the **[edit protocols lldp]** hierarchy level.

The physical topology configuration trap interval determines the period for which trap notifications are sent to the SNMP Master Agent when changes occur in the global physical topology statistics. This capability is disabled by default. The allowable range is from 0 (disabled) through 3600 seconds. The LLDP agent sends traps to the SNMP Master Agent if this interval has a value greater than 0 and there is any change during the **lldp-configuration-notification-interval** trap interval. You adjust this parameter by including the **ptopo-configuration-trap-interval** statement at the **[edit protocols lldp]** hierarchy level.

By default, LLDP generates the SNMP index of the interface for the port ID Type, Length, and Value (TLV). Starting with Junos OS Release 12.3R1, you can generate the interface name as the port ID TLV by including the **interface-name** statement at the **[edit protocols lldp port-id-subtype]** hierarchy level. When the **interface-name** statement is configured on the remote LLDP neighbor, the **show lldp neighbors** command output displays the interface name in the **Port ID** field rather than the SNMP index of the interface, which is displayed by default. If you change the default behavior of generating the SNMP index

of the interface as the Port ID TLV, you can reenable the default behavior by including the **locally-assigned** statement at the `[edit protocols lldp port-id-subtype]` hierarchy level.



**NOTE:** The value of the MIB variable `lldpLocPortId` depends on the SNMP MIB object entity that is used to generate the port ID TLV. If the port ID TLV generation is configured to use the interface name in the `set port-id-subtype interface-name` command, then the value of the MIB variable `lldpLocPortId` is the interface name and not the SNMP index.

#### Related Documentation

- [LLDP Overview on page 315](#)
- [Tracing LLDP Operations on page 320](#)
- [Example: Configuring LLDP on page 319](#)
- *TX Matrix Router Chassis and Interface Names*
- *Monitoring a Routing Matrix with a TX Matrix Router*

## Example: Configuring LLDP

The following example configures LLDP on interface **ge-1/1/1** but disables LLDP on all other interfaces, explicitly configures the default values for all automatically enabled features, and configures a value of 30 seconds for the LLDP configuration notification interval and a value of 30 seconds for the physical topology trap interval.

```
[edit]
protocols {
  lldp {
    advertisement-interval 30;
    hold-multiplier 4;
    interface all {
      disable;
    }
    interface ge-1/1/1;
    lldp-configuration-notification-interval 30;
    ptopo-configuration-maximum-hold-time 300;
    ptopo-configuration-trap-interval 30;
    transmit-delay 2;
  }
}
```

You verify operation of LLDP with several show commands:

- `show lldp <detail>`
- `show lldp neighbors interface-name`
- `show lldp statistics interface-name`
- `show lldp local-information`
- `show lldp remote-global-statistics`

You can clear LLDP neighbor information or statistics globally or on an interface:

- **clear lldp neighbors** *interface-name*
- **clear lldp statistics** *interface-name*

You can display basic information about LLDP with the **show lldp detail** command:

```
user@host> show lldp detail
LLDP                : Enabled
Advertisement interval : 30 Second(s)
Transmit delay       : 2 Second(s)
Hold timer           : 4 Second(s)
Notification interval : 30 Second(s)
Config Trap Interval  : 300 Second(s)
Connection Hold timer : 60 Second(s)
```

Interface	LLDP	Neighbor count
ge-1/1/1	Enabled	0

LLDP basic TLVs supported:

Chassis identifier, Port identifier, Port description, System name, System description, System capabilities, Management address.

LLDP 802 TLVs supported:

Link aggregation, Maximum frame size, MAC/PHY Configuration/Status, Port VLAN ID, Port VLAN name.

For more details about the output of these commands, see the [CLI Explorer](#).

#### Related Documentation

- [LLDP Overview on page 315](#)
- [Configuring LLDP on page 316](#)
- [Tracing LLDP Operations on page 320](#)

---

## Tracing LLDP Operations

To trace LLDP operational traffic, you can specify options in the global **traceoptions** statement included at the **[edit routing-options]** hierarchy level, and you can specify LLDP-specific options by including the **traceoptions** statement:

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols lldp]**
- **[edit routing-instances routing-instance-name protocols lldp]**

You can specify the following LLDP-specific options in the LLDP **traceoptions** statement:

- **all**—Trace all operations.
- **config**—Log configuration events.

- **interface**—Trace interface update events.
- **protocol**—Trace protocol information.
- **rtsock**—Trace real-time socket events.
- **vlan**—Trace VLAN update events.



**NOTE:** Use the trace flag all with caution. This flag may cause the CPU to become very busy.

For general information about tracing and global tracing options, see the statement summary for the global **traceoptions** statement in the *Junos OS Routing Protocols Library for Routing Devices*.

**Related  
Documentation**

- [LLDP Overview on page 315](#)
- [Configuring LLDP on page 316](#)
- [Example: Configuring LLDP on page 319](#)



# Configuring VRRP and VRRP for IPv6

- [VRRP and VRRP for IPv6 Overview on page 323](#)
- [Configuring VRRP and VRRP for IPv6 on page 324](#)

## VRRP and VRRP for IPv6 Overview

---

You can configure the Virtual Router Redundancy Protocol (VRRP) and VRRP for IPv6 for the following interfaces:

- Ethernet
- Fast Ethernet
- Tri-Rate Ethernet copper
- Gigabit Ethernet
- 10-Gigabit Ethernet LAN/WAN PIC
- Ethernet logical interfaces

VRRP and VRRP for IPv6 allow hosts on a LAN to make use of redundant routers on that LAN without requiring more than the static configuration of a single default route on the hosts. The VRRP routers share the IP address corresponding to the default route configured on the hosts. At any time, one of the VRRP routers is the master (active) and the others are backups. If the master fails, one of the backup routers becomes the new master router, thus always providing a virtual default router and allowing traffic on the LAN to be routed without relying on a single router.

VRRP is defined in RFC 3768, *Virtual Router Redundancy Protocol*.

For VRRP and VRRP for IPv6 overview information, configuration guidelines, and statement summaries, see the *Junos OS High Availability Library for Routing Devices*.

**Related  
Documentation**

- [Configuring VRRP and VRRP for IPv6 on page 324](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring VRRP and VRRP for IPv6

To configure VRRP or VRRP for IPv6, include the **vrrp-group** or **vrrp-inet6-group** statement, respectively. These statements are available at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

The VRRP and VRRP IPv6 configuration statements are as follows:

```
(vrrp-group | vrrp-inet-group) group-number {
  (accept-data | no-accept-data);
  advertise-interval seconds;
  authentication-key key;
  authentication-type authentication;
  fast-interval milliseconds;
  (preempt | no-preempt) {
    hold-time seconds;
  }
  priority-number number;
  track {
    priority-hold-time;
    interface interface-name {
      priority-cost priority;
      bandwidth-threshold bits-per-second {
        priority-cost;
      }
    }
  }
  virtual-address [ addresses ];
}
```

You can configure VRRP IPv6 with a global unicast address.

To trace VRRP and VRRP for IPv6 operations, include the **traceoptions** statement at the [edit protocols vrrp] hierarchy level:

```
[edit protocols vrrp]
traceoptions {
  file <filename> <files number> <match regular-expression> <microsecond-stamp>
  <size size> <world-readable | no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

When there are multiple VRRP groups, there is a few seconds delay between the time the first gratuitous ARP is sent out and the rest of the gratuitous ARP are sent. Configuring failover-delay compensates for this delay. To configure the failover delay from 500 to 2000 milliseconds for VRRP and VRRP for IPv6 operations, include the **failover-delay milliseconds** statement at the [edit protocols vrrp] hierarchy level:

```
[edit protocols vrrp]
failover-delay milliseconds;
```



To configure the startup period for VRRP and VRRP for IPv6 operations, include the **startup-silent-period** statement at the **[edit protocols vrrp]** hierarchy level:

```
[edit protocols vrrp]
startup-silent-period seconds;
```

To enable VRRPv3, set the **version-3** statement at the **[edit protocols vrrp]** hierarchy level:

```
[edit protocols vrrp]
version-3;
```

**Related  
Documentation**

- [failover-delay on page 961](#)
- [traceoptions on page 1208](#)
- [failover-delay on page 961](#)
- *vrrp-group*
- [VRRP and VRRP for IPv6 Overview on page 323](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*



## CHAPTER 17

# Configuring Point-to-Point Protocol over Ethernet

- [PPPoE Overview on page 328](#)
- [Configuring PPPoE on page 331](#)
- [Disabling the Sending of PPPoE Keepalive Messages on page 337](#)
- [Verifying a PPPoE Configuration on page 337](#)
- [Tracing PPPoE Operations on page 338](#)
- [Configuring the PPPoE Trace Log Filename on page 340](#)
- [Configuring the Number and Size of PPPoE Log Files on page 340](#)
- [Configuring Access to the PPPoE Log File on page 341](#)
- [Configuring a Regular Expression for PPPoE Lines to Be Logged on page 341](#)
- [Configuring the PPPoE Tracing Flags on page 341](#)
- [Configuring the Severity Level to Filter Which PPPoE Messages Are Logged on page 341](#)

## PPPoE Overview

---

The Point-to-Point Protocol over Ethernet (PPPoE) connects multiple hosts on an Ethernet LAN to a remote site through a single customer premises equipment (CPE) device. Hosts share a common digital subscriber line (DSL), a cable modem, or a wireless connection to the Internet.

To use PPPoE, you must configure the router as a PPPoE client, encapsulate PPP packets over Ethernet, and initiate a PPPoE session.

M120, M320, and MX Series routers can be configured as a PPPoE access concentrator server. To configure a PPPoE server on an M120, M320, or MX Series Ethernet logical interface, specify PPPoE encapsulation, include the **ppp** statement for the pseudo PPPoE physical interface, and include the **server** statement in the PPPoE options under the logical interface.



**NOTE:** PPPoE encapsulation is not supported on M120, M320, or MX Series routers on an ATM2 IQ interface.

Multiple hosts can be connected to the Services Router, and their data can be authenticated, encrypted, and compressed before the traffic is sent to the PPPoE session on the Services Router's Fast Ethernet or ATM-over-ADSL interface. PPPoE is easy to configure and enables services to be managed on a per-user basis rather than on a per-site basis.

This overview contains the following topics:

- [PPPoE Interfaces on page 328](#)
- [PPPoE Stages on page 329](#)
- [Optional CHAP Authentication on page 330](#)

## PPPoE Interfaces

The PPPoE configuration is the same for both interfaces. The only difference is the encapsulation for the underlying interface to the access concentrator:

- If the interface is Fast Ethernet, use a PPPoE encapsulation.
- If the interface is ATM over ADSL, use a PPPoE over ATM encapsulation.

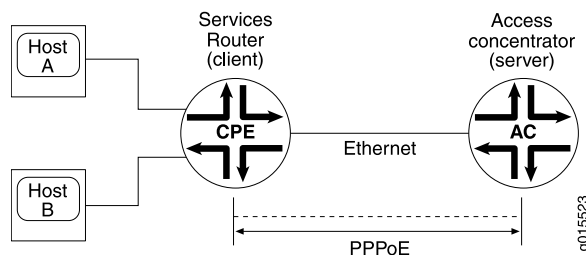
The PPPoE interface on M120 or M320 routers acting as a access concentrator can be a Gigabit Ethernet or 10-Gigabit Ethernet interface.

### Ethernet Interface

---

The Services Router encapsulates each PPP frame in an Ethernet frame and transports the frames over an Ethernet loop. [Figure 22 on page 329](#) shows a typical PPPoE session between a Services Router and an access concentrator on the Ethernet loop.

Figure 22: PPPoE Session on an Ethernet Loop



## PPPoE Stages

PPPoE has two stages, the discovery stage and the PPPoE session stage. In the discovery stage, the client discovers the access concentrator by identifying the Ethernet media access control (MAC) address of the access concentrator and establishing a PPPoE session ID. In the PPPoE session stage, the client and the access concentrator build a point-to-point connection over Ethernet, based on the information collected in the discovery stage.



**NOTE:** If you configure a specific access concentrator name on the client and the same access concentrator name server is available, then a PPPoE session is established. If there is a mismatch between the access concentrator names of the client and the server, the PPPoE session gets closed.

If you do not configure the access concentrator name, the PPPoE session starts using any available server in the network.

## PPPoE Discovery Stage

A Services Router initiates the PPPoE discovery stage by broadcasting a PPPoE active discovery initiation (PADI) packet. To provide a point-to-point connection over Ethernet, each PPPoE session must learn the Ethernet MAC address of the access concentrator and establish a session with a unique session ID. Because the network might have more than one access concentrator, the discovery stage allows the client to communicate with all of them and select one.



**NOTE:** A Services Router cannot receive PPPoE packets from two different access concentrators on the same physical interface.

The PPPoE discovery stage consists of the following steps:

1. PPPoE active discovery initiation (PADI)—The client initiates a session by broadcasting a PADI packet on the LAN to request a service.
2. PPPoE active discovery offer (PADO)—Any access concentrator that can provide the service requested by the client in the PADI packet replies with a PADO packet that contains its own name, the unicast address of the client, and the service requested. An access concentrator can also use the PADO packet to offer other services to the client.

3. PPPoE active discovery request (PADR)—From the PADOs it receives, the client selects one access concentrator based on its name or the services offered and sends it a PADR packet to indicate the service or services needed.
4. PPPoE active discovery session-Confirmation (PADS)—When the selected access concentrator receives the PADR packet, it accepts or rejects the PPPoE session.
  - To accept the session, the access concentrator sends the client a PADS packet with a unique session ID for a PPPoE session and a service name that identifies the service under which it accepts the session.
  - To reject the session, the access concentrator sends the client a PADS packet with a service name error and resets the session ID to zero.

---

### PPPoE Session Stage

The PPPoE session stage starts after the PPPoE discovery stage is over. The access concentrator can start the PPPoE session after it sends the PADS packet to the client, or the client can start the PPPoE session after it receives a PADS packet from the access concentrator. A Services Router supports multiple PPPoE sessions on each interface, but no more than 256 PPPoE sessions on all interfaces on the Services Router.

Each PPPoE session is uniquely identified by the Ethernet address of the peer and the session ID. After the PPPoE session is established, data is sent as in any other PPP encapsulation. The PPPoE information is encapsulated within an Ethernet frame and is sent to a unicast address. In this stage, both the client and the server must allocate resources for the PPPoE logical interface.

After a session is established, the client or the access concentrator can send a PPPoE active discovery termination (PADT) packet anytime to terminate the session. The PADT packet contains the destination address of the peer and the session ID of the session to be terminated. After this packet is sent, the session is closed to PPPoE traffic.

## Optional CHAP Authentication

For interfaces with PPPoE encapsulation, you can configure interfaces to support the PPP Challenge Handshake Authentication Protocol (CHAP). When you enable CHAP on an interface, the interface can authenticate its peer and be authenticated by its peer.

If you configure an interface to handle incoming CHAP packets only (by including the **passive** statement at the **[edit interfaces *interface-name* ppp-options chap]** hierarchy level), the interface does not challenge its peer. However, if the interface is challenged, it responds to the challenge. If you do not include the **passive** statement, the interface always challenges its peer.

For more information about CHAP, see *Configuring the PPP Challenge Handshake Authentication Protocol*.

#### Related Documentation

- *Configuring the PPP Challenge Handshake Authentication Protocol*
- *Developing a Log Storage Strategy*
- *Evaluation Order for Matching Client Information in PPPoE Service Name Tables*

- *Benefits of Configuring PPPoE Service Name Tables*
- [Configuring PPPoE on page 331](#)
- [Disabling the Sending of PPPoE Keepalive Messages on page 337](#)
- *Configuring PPPoE Service Name Tables*
- *Creating a Service Name Table*
- *Configuring the Action Taken When the Client Request Includes an Empty Service Name Tag*
- *Configuring the Action Taken for the Any Service*
- *Assigning a Service to a Service Name Table and Configuring the Action Taken When the Client Request Includes a Non-zero Service Name Tag*
- *Assigning an ACI/ARI Pair to a Service Name and Configuring the Action Taken When the Client Request Includes ACI/ARI Information*
- *Limiting the Number of Active PPPoE Sessions Established with a Specified Service Name*
- *Reserving a Static PPPoE Interface for Exclusive Use by a PPPoE Client*
- *Enabling Advertisement of Named Services in PADO Control Packets*
- *Assigning a Service Name Table to a PPPoE Underlying Interface*
- *Example: Configuring a PPPoE Service Name Table*
- [Tracing PPPoE Operations on page 338](#)
- *Troubleshooting PPPoE Service Name Tables*
- [Verifying a PPPoE Configuration on page 337](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring PPPoE

---

- [Overview on page 332](#)
- [Setting the Appropriate Encapsulation on the PPPoE Interface on page 332](#)
- [Configuring PPPoE Encapsulation on an Ethernet Interface on page 333](#)
- [Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface on page 333](#)
- [Configuring the PPPoE Underlying Interface on page 334](#)
- [Identifying the Access Concentrator on page 334](#)
- [Configuring the PPPoE Automatic Reconnect Wait Timer on page 334](#)
- [Configuring the PPPoE Service Name on page 335](#)
- [Configuring the PPPoE Server Mode on page 335](#)
- [Configuring the PPPoE Client Mode on page 335](#)
- [Configuring the PPPoE Source and Destination Addresses on page 335](#)
- [Deriving the PPPoE Source Address from a Specified Interface on page 336](#)

- [Configuring the PPPoE IP Address by Negotiation on page 336](#)
- [Configuring the Protocol MTU PPPoE on page 336](#)
- [Example: Configuring a PPPoE Server Interface on an M120 or M320 Router on page 337](#)

## Overview

To configure PPPoE on an M120 or M320 Multiservice Edge Router or MX Series Universal Edge Router operating as an access concentrator, perform the following tasks:

1. Configure PPPoE encapsulation for an Ethernet interface.
2. Specify the logical Ethernet interface as the underlying interface for the PPPoE session.
3. Optionally, configure the maximum transmission unit (MTU) of the interface.
4. Configure the operational mode as server.
5. Configure the PPPoE interface address.
6. Configure the destination PPPoE interface address.
7. Optionally, configure the MTU size for the protocol family.
8. Optionally, configure one or more PPPoE service name tables and the action taken for each service in the tables.
9. Optionally, disable the sending of PADS messages that contain certain error tags.



**NOTE:** When you configure a static PPPoE logical interface, you must include the `pppoe-options` subhierarchy at the `[edit interfaces pp0 unit logical-unit-number]` hierarchy level or at the `[edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number]` hierarchy level. If you omit the `pppoe-options` subhierarchy from the configuration, the commit operation fails.

## Setting the Appropriate Encapsulation on the PPPoE Interface

For PPPoE on an Ethernet interface, you must configure encapsulation on the logical interface and use PPP over Ethernet encapsulation.

For PPPoE on an ATM-over-ADSL interface, you must configure encapsulation on both the physical and logical interfaces. To configure encapsulation on an ATM-over-ADSL physical interface, use Ethernet over ATM encapsulation. To configure encapsulation on an ATM-over-ADSL logical interface, use PPPoE over AAL5 LLC encapsulation. LLC encapsulation allows a single ATM virtual connection to transport multiple protocols.



**NOTE:** PPPoE encapsulation is not supported on an M120 or M320 router on an ATM2 IQ interface.



When you configure a point-to-point encapsulation such as PPP on a physical interface, the physical interface can have only one logical interface (only one **unit** statement) associated with it.

To configure physical interface properties, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level:

```
[edit interfaces interface-name]  
encapsulation ethernet-over-atm;
```

To configure logical interface encapsulation properties, include the **encapsulation** statement:

```
encapsulation ppp-over-ether;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]**

Perform the task appropriate for the interface on which you are using PPPoE. For more information on how to configure PPOE encapsulation on an ethernet interface and on an ATM-over-ADSL interface, see “[Configuring PPPoE Encapsulation on an Ethernet Interface](#)” on page 333 and “[Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface](#)” on page 333.

## Configuring PPPoE Encapsulation on an Ethernet Interface

Both the client and the server must be configured to support PPPoE. To configure PPPoE encapsulation on an Ethernet interface, include the **encapsulation** statement:

```
encapsulation ppp-over-ether;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces *pp0* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *pp0* unit *logical-unit-number*]**

## Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface

To configure the PPPoE encapsulation on a ATM-over-ADSL interface, perform the following steps:

1. Include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level, and specify **ethernet-over-atm**:

```
[edit interfaces pp0]  
encapsulation ethernet-over-atm;
```

2. Configure LLC encapsulation on the logical interface by including the **encapsulation** statement and specifying **ppp-over-ether-over-atm-llc**:

```
encapsulation ppp-over-ether-over-atm-llc;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number*]

## Configuring the PPPoE Underlying Interface

To configure the underlying Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or ATM interface, include the **underlying-interface** statement:

```
underlying-interface interface-name;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

Specify the logical Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or ATM interface as the underlying interface—for example, **at-0/0/1.0** (ATM VC), **fe-1/0/1.0** (Fast Ethernet interface), or **ge-2/0/0** (Gigabit Ethernet interface).

## Identifying the Access Concentrator

When configuring a PPPoE client, identify the access concentrator by a unique name by including the **access-concentrator** statement:

```
access-concentrator name;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

## Configuring the PPPoE Automatic Reconnect Wait Timer

By default, after a PPPoE session is terminated, the session attempts to reconnect immediately. When configuring a PPPoE client, you can specify how many seconds to wait before attempting to reconnect, by including the **auto-reconnect** statement:

```
auto-reconnect seconds;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

You can configure the reconnection attempt to occur in 0 through 4,294,967,295 seconds after the session terminates.

## Configuring the PPPoE Service Name

When configuring a PPPoE client, identify the type of service provided by the access concentrator—such as the name of the Internet service provider (ISP), class, or quality of service—by including the **service-name** statement:

```
service-name name;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

## Configuring the PPPoE Server Mode

When configuring a PPPoE server, identify the mode by including the **server** statement:

```
server;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

## Configuring the PPPoE Client Mode

When configuring a PPPoE client, identify the mode by including the **client** statement:

```
client;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]
- [edit logical-systems *logical-system-name* interfaces pp0 **unit** *logical-unit-number* **pppoe-options**]

## Configuring the PPPoE Source and Destination Addresses

When configuring a PPPoE client or server, assign source and destination addresses—for example, 192.168.1.1/32 and 192.168.1.2. To assign the source and destination address, include the **address** and **destination** statements:

```
address address {
  destination address;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces pp0.0 family inet]
- [edit logical-systems *logical-system-name* interfaces pp0.0 family inet]

## Deriving the PPPoE Source Address from a Specified Interface

For a router supporting PPPoE, you can derive the source address from a specified interface—for example, the loopback interface, **lo0.0**—and assign a destination address—for example, **192.168.1.2**. The specified interface must include a logical unit number and have a configured IP address. To derive the source address and assign the destination address, include the **unnumbered-address** and **destination** statements:

```
unnumbered-address interface-name destination address;  
}
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces pp0.0 family inet]**
- **[edit logical-systems *logical-system-name* interfaces pp0.0 family inet]**

## Configuring the PPPoE IP Address by Negotiation

You can have the PPPoE client router obtain an IP address by negotiation with the remote end. This method might require the access concentrator to use a RADIUS authentication server. To obtain an IP address from the remote end by negotiation, include the **negotiate-address** statement:

```
negotiate-address;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces pp0.0 family (inet | inet6 | mpls)]**
- **[edit logical-systems *logical-system-name* interfaces pp0.0 family (inet | inet6 | mpls)]**

## Configuring the Protocol MTU PPPoE

You can configure the maximum transmission unit (MTU) size for the protocol family. Specify a range from 0 through 5012 bytes. Ensure that the size of the media MTU is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. To set the MTU, include the **mtu** statement:

```
mtu bytes;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces pp0.0 family (inet | inet6 | mpls)]**
- **[edit logical-systems *logical-system-name* interfaces pp0.0 family (inet | inet6 | mpls)]**

You can modify the MTU size of the interface by including the **mtu bytes** statement at the **[edit interfaces pp0]** hierarchy level:

```
[edit interfaces pp0]  
mtu bytes;
```

The default media MTU size used and the range of available sizes on a physical interface depends on the encapsulation used on that interface.

## Example: Configuring a PPPoE Server Interface on an M120 or M320 Router

Configure a PPPoE server over a Gigabit Ethernet interface:

```
[edit interfaces]
ge-1/0/0 {
  vlan-tagging;
  unit 1 {
    encapsulation ppp-over-ether;
    vlan-id 10;
  }
}
pp0 {
  unit 0 {
    pppoe-options {
      underlying-interface ge-1/0/0.0;
      server;
    }
    ppp-options {
    }
    family inet {
      address 22.2.2.1/32 {
        destination 22.2.2.2;
      }
    }
  }
}
```

- Related Documentation**
- [PPPoE Overview on page 328](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Disabling the Sending of PPPoE Keepalive Messages

When configuring the client, you can disable the sending of keepalive messages on a logical interface by including the **no-keepalives** statement:

```
no-keepalives;
```

You can include this statement at the following hierarchy levels:

- `[edit interfaces pp0 unit logical-unit-number]`
- `[edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number]`

- Related Documentation**
- [PPPoE Overview on page 328](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Verifying a PPPoE Configuration

**Purpose** You can use show commands to display and verify the PPPoE configuration.

**Action** To verify a PPPoE configuration, you can issue the following operational mode commands:

- `show interfaces at-fpc/pic/port extensive`
- `show interfaces pp0`
- `show pppoe interfaces`
- `show pppoe version`
- `show pppoe service-name-tables`
- `show pppoe sessions`
- `show pppoe statistics`
- `show pppoe underlying-interfaces`

For more information about these operational mode commands, see [CLI Explorer](#).

- Related Documentation**
- [PPPoE Overview on page 328](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Tracing PPPoE Operations

The Junos OS trace feature tracks PPPoE operations and records events in a log file. The error descriptions captured in the log file provide detailed information to help you solve problems.

By default, nothing is traced. When you enable the tracing operation, the default tracing behavior is as follows:

1. Important events are logged in a file called **pppoed** located in the **/var/log** directory. You cannot change the directory (**/var/log**) in which trace files are located.
2. When the file **pppoed** reaches 128 kilobytes (KB), it is renamed **pppoed.0**, then **pppoed.1**, and finally **pppoed.2**, until there are three trace files. Then the oldest trace file (**pppoed.2**) is overwritten.

You can optionally specify the number of trace files to be from 2 through 1000. You can also configure the maximum file size to be from 10 KB through 1 gigabyte (GB). (For more information about how log files are created, see the [System Log Explorer](#).)

By default, only the user who configures the tracing operation can access log files. You can optionally configure read-only access for all users.

To configure PPPoE tracing operations:

1. Specify that you want to configure tracing options.  

```
[edit protocols pppoe]  
user@host# edit traceoptions
```
2. (Optional) Configure the name for the file used for the trace output.

3. (Optional) Configure the number and size of the log files.
4. (Optional) Configure access to the log file.
5. (Optional) Configure a regular expression to filter logging events.
6. (Optional) Configure flags to filter the operations to be logged.

Optional PPPoE traceoptions operations are described in the following sections:

- [Configuring the PPPoE Trace Log Filename on page 339](#)
- [Configuring the Number and Size of PPPoE Log Files on page 339](#)
- [Configuring Access to the PPPoE Log File on page 339](#)
- [Configuring a Regular Expression for PPPoE Lines to Be Logged on page 339](#)
- [Configuring the PPPoE Tracing Flags on page 340](#)

## Configuring the PPPoE Trace Log Filename

By default, the name of the file that records trace output for PPPoE is **pppoed**. You can specify a different name with the **file** option.

## Configuring the Number and Size of PPPoE Log Files

You can optionally specify the number of compressed, archived trace log files to be from 2 through 1000. You can also configure the maximum file size to be from 10 KB through 1 gigabyte (GB); the default size is 128 kilobytes (KB).

The archived files are differentiated by a suffix in the format **.number.gz**. The newest archived file is **.0.gz** and the oldest archived file is **.(maximum number)-1.gz**. When the current trace log file reaches the maximum size, it is compressed and renamed, and any existing archived files are renamed. This process repeats until the maximum number of archived files is reached, at which point the oldest file is overwritten.

For example, you can set the maximum file size to 2 MB, and the maximum number of files to 20. When the file that receives the output of the tracing operation, **filename**, reaches 2 MB, **filename** is compressed and renamed **filename.0.gz**, and a new file called **filename** is created. When the new **filename** reaches 2 MB, **filename.0.gz** is renamed **filename.1.gz** and **filename** is compressed and renamed **filename.0.gz**. This process repeats until there are 20 trace files. Then the oldest file, **filename.19.gz**, is simply overwritten when the next oldest file, **filename.18.gz** is compressed and renamed to **filename.19.gz**.

## Configuring Access to the PPPoE Log File

By default, only the user who configures the tracing operation can access the log files. You can enable all users to read the log file and you can explicitly set the default behavior of the log file.

## Configuring a Regular Expression for PPPoE Lines to Be Logged

By default, the trace operation output includes all lines relevant to the logged events.

You can refine the output by including regular expressions to be matched.

## Configuring the PPPoE Tracing Flags

By default, no events are logged. You can specify which events and operations are logged by specifying one or more tracing flags.

To configure the flags for the events to be logged, configure the flags:

- [edit protocols pppoe [traceoptions](#)]  
user@host# set flag authentication

### Related Documentation

- [PPPoE Overview on page 328](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring the PPPoE Trace Log Filename

By default, the name of the file that records trace output for PPPoE is **pppoed**. You can specify a different name with the **file** option.

### Related Documentation

- [Tracing PPPoE Operations on page 338](#)
- [traceoptions \(PPPoE\) on page 1212](#)

---

## Configuring the Number and Size of PPPoE Log Files

You can optionally specify the number of compressed, archived trace log files to be from 2 through 1000. You can also configure the maximum file size to be from 10 KB through 1 gigabyte (GB); the default size is 128 kilobytes (KB).

The archived files are differentiated by a suffix in the format **.number.gz**. The newest archived file is **.0.gz** and the oldest archived file is **.(maximum number)-1.gz**. When the current trace log file reaches the maximum size, it is compressed and renamed, and any existing archived files are renamed. This process repeats until the maximum number of archived files is reached, at which point the oldest file is overwritten.

For example, you can set the maximum file size to 2 MB, and the maximum number of files to 20. When the file that receives the output of the tracing operation, **filename**, reaches 2 MB, **filename** is compressed and renamed **filename.0.gz**, and a new file called **filename** is created. When the new **filename** reaches 2 MB, **filename.0.gz** is renamed **filename.1.gz** and **filename** is compressed and renamed **filename.0.gz**. This process repeats until there are 20 trace files. Then the oldest file, **filename.19.gz**, is simply overwritten when the next oldest file, **filename.18.gz** is compressed and renamed to **filename.19.gz**.

### Related Documentation

- [Tracing PPPoE Operations on page 338](#)
- [traceoptions \(PPPoE\) on page 1212](#)



## Configuring Access to the PPPoE Log File

---

By default, only the user who configures the tracing operation can access the log files. You can enable all users to read the log file and you can explicitly set the default behavior of the log file.

- Related Documentation**
- [Tracing PPPoE Operations on page 338](#)
  - [traceoptions \(PPPoE\) on page 1212](#)

## Configuring a Regular Expression for PPPoE Lines to Be Logged

---

By default, the trace operation output includes all lines relevant to the logged events.

You can refine the output by including regular expressions to be matched.

- Related Documentation**
- [Tracing PPPoE Operations on page 338](#)
  - [traceoptions \(PPPoE\) on page 1212](#)

## Configuring the PPPoE Tracing Flags

---

By default, no events are logged. You can specify which events and operations are logged by specifying one or more tracing flags.

To configure the flags for the events to be logged, configure the flags:

- `[edit protocols pppoe traceoptions]  
user@host# set flag authentication`

- Related Documentation**
- [Tracing PPPoE Operations on page 338](#)

## Configuring the Severity Level to Filter Which PPPoE Messages Are Logged

---

The messages associated with a logged event are categorized according to severity level. You can use the severity level to determine which messages are logged for the event type. The severity level that you configure depends on the issue that you are trying to resolve. In some cases you might be interested in seeing all messages relevant to the logged event, so you specify **all** or **verbose**. Either choice generates a large amount of output. You can specify a more restrictive severity level, such as **notice** or **info** to filter the messages. By default, the trace operation output includes only messages with a severity level of **error**.

To configure the type of messages to be logged:

- Configure the message severity level.  
`[edit protocols pppoe]  
user@host# set level severity`

- Related Documentation**
- [Tracing PPPoE Operations on page 338](#)
  - [traceoptions \(PPPoE\) on page 1212](#)

# Configuring Restricted and Unrestricted Proxy ARP

- [Restricted and Unrestricted Proxy ARP Overview on page 343](#)
- [Configuring Restricted and Unrestricted Proxy ARP on page 345](#)

## Restricted and Unrestricted Proxy ARP Overview

---

By default, the Junos OS responds to an Address Resolution Protocol (ARP) request only if the destination address of the ARP request is local to the incoming interface.

For Ethernet Interfaces, you can configure the router or switches to proxy-reply to the ARP requests using the restricted or unrestricted proxy ARP configuration.

You might want to configure restricted or unrestricted proxy ARP for routers that act as provider edge (PE) devices in Ethernet Layer 2 LAN switching domains.



**NOTE:** From Junos OS Release 10.0 onward, Junos OS does not respond to proxy ARP requests with the default route 0.0.0.0. This behavior is in compliance with RFC 1027.

## Restricted Proxy ARP

Restricted proxy ARP enables the router or switch to respond to the ARP requests in which the physical networks of the source and target are not the same and the router or switch has an active route to the target address in the ARP request. The router does not reply if the target address is on the same subnet and the same interface as the ARP requestor.

## Unrestricted Proxy ARP

Unrestricted proxy ARP enables the router or switch to respond to any ARP request, on condition that the router has an active route to the destination address of the ARP request. The route is not limited to the incoming interface of the request, nor is it required to be a direct route.



**WARNING:** If you configure unrestricted proxy ARP, the proxy router replies to ARP requests for the target IP address on the same interface as the incoming ARP request. This behavior is appropriate for cable modem termination system (CMTS) environments, but might cause Layer 2 reachability problems if you enable unrestricted proxy ARP in other environments.

When an IP client broadcasts the ARP request across the Ethernet wire, the end node with the correct IP address responds to the ARP request and provides the correct MAC address. If the unrestricted proxy ARP feature is enabled, the router response is redundant and might fool the IP client into determining that the destination MAC address within its own subnet is the same as the address of the router.



**NOTE:** While the destination address can be remote, the source address of the ARP request must be on the same subnet as the interface upon which the ARP request is received. For security reasons, this rule applies to both unrestricted and restricted proxy ARP.

## Topology Considerations for Unrestricted Proxy ARP

In most situations, you should not configure the router or switch to perform unrestricted proxy ARP. Do so only for special situations, such as when cable modems are used. [Figure 23 on page 344](#) and [Figure 24 on page 345](#) show examples of situations in which you might want to configure unrestricted proxy ARP.

In [Figure 23 on page 344](#), the edge device is not running any IP protocols. In this case, you configure the core router to perform unrestricted proxy ARP. The edge device is the client of the proxy.

In [Figure 24 on page 345](#), the Broadband Remote Access Server (B-RAS) routers are not running any IP protocols. In this case, you configure unrestricted proxy ARP on the B-RAS interfaces. This allows the core device to behave as though it is directly connected to the end users.

**Figure 23: Edge Device Case for Unrestricted Proxy ARP**

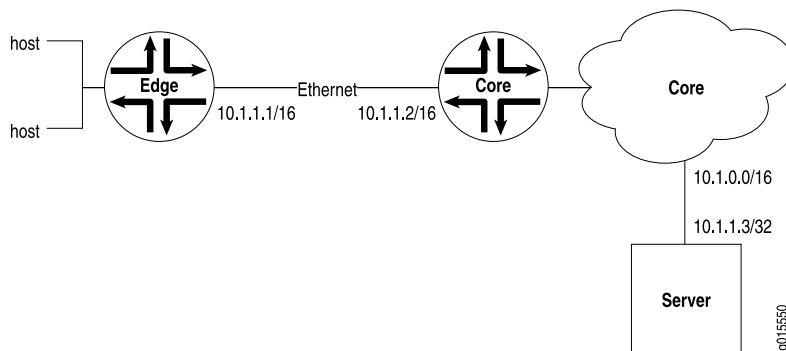
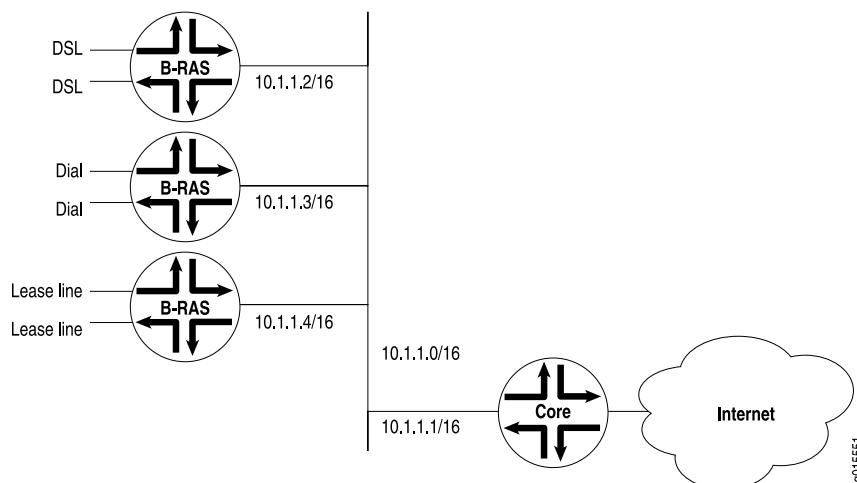


Figure 24: Core Device Case for Unrestricted Proxy ARP



- Related Documentation**
- [Configuring Restricted and Unrestricted Proxy ARP on page 345](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Restricted and Unrestricted Proxy ARP

To configure restricted or unrestricted proxy ARP, include the **proxy-arp** statement:

**proxy-arp** (restricted |unrestricted);

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

To return to the default—that is, to disable restricted or unrestricted proxy ARP—delete the **proxy-arp** statement from the configuration:

```
[edit]
user@host# delete interfaces interface-name unit logical-unit-number proxy-arp
```

You can track the number of restricted or unrestricted proxy ARP requests processed by the router or switch by issuing the **show system statistics arp** operational mode command.



NOTE: When proxy ARP is enabled as default or unrestricted, the router or switch responds to any ARP request as long as the device has an active route to the target address of the ARP request. This gratuitous ARP behavior can result in an error when the receiving interface and target response interface are the same and the end device (for example, a client) performs a duplicate address check. To prevent this error, configure the router or switch interface with the `no-gratuitous-arp-reply` statement. See “[Configuring Gratuitous ARP](#)” on [page 18](#) for information about how to disable responses to gratuitous ARP requests.

**Related  
Documentation**

- [proxy-arp on page 1144](#)
- [Restricted and Unrestricted Proxy ARP Overview on page 343](#)
- [Configuring Gratuitous ARP on page 18](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## CHAPTER 19

# Configuring Static ARP Table Entries

- [Static ARP Table Entries Overview on page 347](#)
- [Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses on page 348](#)

### Static ARP Table Entries Overview

---

For Fast Ethernet, Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, you can configure static ARP table entries, defining mappings between IP and MAC addresses.

#### **Related Documentation**

- [Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses on page 348](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses

By default, the device responds to an Address Resolution Protocol (ARP) request only if the destination address of the ARP request is on the local network of the incoming interface. For Fast Ethernet or Gigabit Ethernet interfaces, you can configure static ARP entries that associate the IP addresses of nodes on the same Ethernet subnet with their media access control (MAC) addresses. These static ARP entries enable the device to respond to ARP requests even if the destination address of the ARP request is not local to the incoming Ethernet interface.

Also, unlike dynamically learned ARP entries, static ARP entries do not age out. You can also configure static ARP entries in a troubleshooting situation or if your device is unable to learn a MAC address dynamically.



**NOTE:** By default, an ARP policer is installed that is shared among all the Ethernet interfaces on which you have configured the `family inet` statement. By including the `arp` statement at the `[edit interfaces interface-name unit logical-unit-number family inet policer]` hierarchy level, you can apply a specific ARP-packet policer to an interface. This feature is not available on EX Series switches.

To configure static ARP entries:

1. In the configuration mode, at the `[edit]` hierarchy level, configure the router interface on which the ARP table entries for the router is configured.

```
[edit]
user@host# edit interfaces interface-name
```

2. Configure the protocol family, the logical unit of the interface, and the interface address of the router interface at the `[edit interfaces interface-name]` hierarchy level. While configuring the protocol family, specify `inet` as the protocol family.



**NOTE:** When you need to conserve IP addresses, you can configure an Ethernet interface to be unnumbered by including the `unnumbered-address` statement at the `[edit interfaces interface-name unit logical-unit-number family inet]` hierarchy level.

```
[edit interfaces interface-name]
user@host# edit unit logical-unit-number family inet address interface-address
```

3. Configure a static ARP entry by specifying the IP address and the MAC address that are to be mapped to each other. The IP address specified must be part of the subnet defined in the enclosing `address` statement. The MAC address must be specified as hexadecimal bytes in the following formats: `nnnn.nnnn.nnnn` or `nn:nn:nn:nn:nn:nn` format. For instance, you can use either `0011.2233.4455` or `00:11:22:33:44:55`.

```
[edit interfaces interface-name unit logical-unit-number family inet address
interface-address
```



```
user@host# set arp ip-address mac mac-address
```

4. Configure another static ARP entry by specifying the IP address and the MAC address that are to be mapped to each other. You can also associate a multicast MAC address with a unicast IP address by including the **multicast-mac** option with the **arp** statement. You can optionally configure the router to respond to ARP requests for the specified IP address by using the **publish** option with the **arp** statement.



**NOTE:** For unicast MAC addresses only, if you include the **publish** option, the router or switch replies to proxy ARP requests.

```
[edit interfaces interface-name unit logical-unit-number family inet address
 interface-address
 user@host# set arp ip-address multicast-mac mac-address publish
```



**NOTE:** The Junos OS supports the IPv6 static neighbor discovery cache entries, similar to the static ARP entries in IPv4.

#### Related Documentation

- [arp on page 877](#)
- [Static ARP Table Entries Overview on page 347](#)
- [Management Ethernet Interface Overview on page 25](#)
- [EX Series Switches Interfaces Overview](#)
- [Applying Policers](#)
- [Configuring an Unnumbered Interface](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)



# Configuring TCC and Layer 2.5 Switching

- [TCC and Layer 2.5 Switching Overview on page 351](#)
- [Configuring VLAN TCC Encapsulation on page 351](#)
- [Configuring Translation Cross-Connect Interface Switching on page 353](#)

## TCC and Layer 2.5 Switching Overview

---

Translational cross-connect (TCC) is a switching concept that allows you to forward traffic between a variety of Layer 2 protocols or circuits. It is similar to its predecessor, CCC. However, while CCC requires the same Layer 2 encapsulations on both sides of a router (such as Point-to-Point Protocol [PPP] or Frame Relay-to-Frame Relay), TCC lets you connect different types of Layer 2 protocols interchangeably. With TCC, combinations such as PPP-to-ATM and Ethernet-to-Frame Relay cross-connections are possible.

### Related Documentation

- [Configuring VLAN TCC Encapsulation on page 351](#)
- [Configuring Translation Cross-Connect Interface Switching on page 353](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring VLAN TCC Encapsulation

---

VLAN TCC encapsulation allows circuits to have different media on either side of the forwarding path. VLAN TCC encapsulation supports TPID 0x8100 only. You must include configuration statements at the logical and physical interface hierarchy levels.

To configure VLAN TCC encapsulation, include the **encapsulation** statement and specify the **vlan-tcc** option:

```
[edit interfaces interface-name unit logical-unit-number]  
encapsulation vlan-tcc;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Additionally, configure the logical interface by including the **proxy** and **remote** statements:

```
proxy {  
    inet-address;  
}  
remote {  
    (inet-address | mac-address);  
}
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number* family tcc]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]**

The proxy address is the IP address of the non-Ethernet TCC neighbor for which the TCC router is acting as a proxy.

The remote address is the IP or MAC address of the remote router. The **remote** statement provides ARP capability from the TCC switching router to the Ethernet neighbor. The MAC address is the physical Layer 2 address of the Ethernet neighbor.

When VLAN TCC encapsulation is configured on the logical interface, you also must specify flexible Ethernet services on the physical interface. To specify flexible Ethernet services, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level and specify the **flexible-ethernet-services** option:

```
[edit interfaces interface-name]  
encapsulation flexible-ethernet-services;
```

Extended VLAN TCC encapsulation supports TPIDs 0x8100 and 0x9901. Extended VLAN TCC is specified at the physical interface level. When configured, all units on that interface must use VLAN TCC encapsulation, and no explicit configuration is needed on logical interfaces.

One-port Gigabit Ethernet, 2-port Gigabit Ethernet, and 4-port Fast Ethernet PICs with VLAN tagging enabled can use VLAN TCC encapsulation. To configure the encapsulation on a physical interface, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level and specify the **extended-vlan-tcc** option:

```
[edit interfaces interface-name]  
encapsulation extended-vlan-tcc;
```

For VLAN TCC encapsulation, all VLAN IDs from 1 through 1024 are valid. VLAN ID 0 is reserved for tagging the priority of frames.

Extended VLAN TCC is not supported on 4-port Gigabit Ethernet PICs.

#### Related Documentation

- [encapsulation on page 941](#)
- [remote on page 1152](#)
- [proxy on page 1143](#)
- [TCC and Layer 2.5 Switching Overview on page 351](#)

- [Configuring Translation Cross-Connect Interface Switching on page 353](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Translation Cross-Connect Interface Switching

To configure a full-duplex Layer 2.5 translation cross-connect between two routers (A and C), you can configure a Juniper Networks router (Router B) as the TCC interface. Ethernet TCC encapsulation provides an Ethernet wide area circuit for interconnecting IP traffic. Consider the topology in [Figure 25 on page 353](#) where the Router A-to-Router B circuit is PPP, and the Router B-to-Router C circuit accepts packets carrying standard TPID values.

Figure 25: Sample Topology of Layer 2.5 Translational Cross-Connect



If traffic flows from Router A to Router C, the Junos OS strips all PPP encapsulation data from incoming packets and adds Ethernet encapsulation data before forwarding the packets. If traffic flows from Router C to Router A, the Junos OS strips all Ethernet encapsulation data from incoming packets and adds PPP encapsulation data before forwarding the packets.

To configure the router as the translational cross-connect interface:

1. In the configuration mode, at the `[edit]` hierarchy level, first configure the interface that is connected to Router A.
 

```
[edit]
user@host# edit interfaces interface-name
```
2. (Optional) Specify the description of the interface. For example, you could specify the interface name on Router A that is connected to this interface.
 

```
[edit interfaces interface-name]
user@host# set description description
```
3. Specify the encapsulation. If the Router A to Router B circuit is PPP, then specify **ppp-tcc** as the encapsulation. If the Router A to Router B circuit is frame relay, specify **frame-relay-tcc**.
 

```
[edit interfaces interface-name]
user@host# set encapsulation encapsulation-type
```
4. In the configuration mode, at the `[edit]` hierarchy level, first configure the interface that is connected to Router C.
 

```
[edit]
user@host# edit interfaces interface-name
```
5. (Optional) Specify the description of this interface. For example, you could specify the interface name on Router C that is connected to this interface.

```
[edit interfaces interface-name]  
user@host# set description description
```

6. Specify the encapsulation. If the Router B to Router C circuit is Ethernet, then specify **ethernet-tcc** as the encapsulation. If the Router B to Router C circuit is ATM, specify **atm-tcc-vc-mux**.

```
[edit interfaces interface-name]  
user@host# set encapsulation encapsulation-type
```

7. Specify the IP address or MAC address of the remote router to provide address resolution protocol (ARP) for the TCC router's Ethernet-based neighbor using the **remote** statement. You must specify the statement at the **[edit interfaces interface-name unit unit-number family tcc]** hierarchy level. You can specify the MAC address of the remote router instead of the IP address. The MAC address is the physical Layer 2 address of the Ethernet neighbor.

```
[edit interfaces interface-name]  
user@host# set unit 0 family family remote inet-address ip-address
```

8. Specify the IP address of the non-Ethernet TCC neighbor for which the TCC router is acting as a proxy using the **proxy** statement. You must specify the statement at the **[edit interfaces interface-name unit unit-number family tcc]** hierarchy level.

```
[edit interfaces interface-name]  
user@host# set unit 0 family family proxy inet-address ip-address
```

To verify the TCC connection, use the **show connections** command on TCC router.

**Related  
Documentation**

- [encapsulation on page 941](#)
- [remote on page 1152](#)
- [proxy on page 1143](#)
- [TCC and Layer 2.5 Switching Overview on page 351](#)
- [Configuring VLAN TCC Encapsulation on page 351](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## PART 2

# Gigabit Ethernet Interfaces

- [Configuring 10-Gigabit Ethernet LAN/WAN PICs on page 357](#)
- [Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength on page 381](#)
- [Configuring 10-Gigabit Ethernet Framing on page 385](#)
- [Configuring 10-Gigabit Ethernet Notification of Link Down Alarm on page 389](#)
- [Configuring 40-Gigabit Ethernet PICs on page 391](#)
- [Configuring 100-Gigabit Ethernet PICs/MICs on page 395](#)
- [Configuring Gigabit Ethernet OTN Options on page 421](#)
- [Configuring Gigabit Ethernet Accounting and Policing on page 455](#)
- [Configuring Gigabit Ethernet Autonegotiation on page 477](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 483](#)





## CHAPTER 21

# Configuring 10-Gigabit Ethernet LAN/WAN PICs

- [10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357](#)
- [12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 361](#)
- [24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 363](#)
- [Modes of Operation of 10-Gigabit Ethernet PICs on page 365](#)
- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 365](#)
- [Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 366](#)
- [Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 369](#)
- [Configuring Mixed-Rate Mode Operation on page 370](#)
- [P2-10G-40G-QSFPP PIC Overview on page 371](#)
- [Configuring the P2-10G-40G-QSFPP PIC on page 375](#)
- [Example: Configuring the P2-10G-40G-QSFPP PIC on page 378](#)

## 10-port 10-Gigabit Ethernet LAN/WAN PIC Overview

---

This section describes the main features and caveats of the 10-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PD-5-10XGE-SFPP) and specifies which routers support this PIC.

The 10-port 10-Gigabit Ethernet LAN/WAN PIC (PD-5-10XGE-SFPP) is supported on Juniper Networks T640 Core Routers, T1600 Core Routers, and T4000 Core Routers. It has the following features:

- Access to all 10-Gigabit Ethernet port counters through SNMP
- Intelligent handling of oversubscribed traffic in applications such as data centers and dense-core uplinks
- Line-rate operation for five 10-Gigabit Ethernet ports from each port group, or a total WAN bandwidth of 100 Gbps with Packet Forwarding Engine bandwidth of 50 Gbps
- Flexible encapsulation, source address and destination address media access control (MAC) filtering, source address MAC learning, MAC accounting, and MAC policing

- Interface encapsulations, such as the following:
  - **ethernet-ccc**—Ethernet cross-connect
  - **vlan-ccc**—802.1Q tagging for a cross-connect
  - **ethernet-tcc**—Ethernet translational cross-connect
  - **vlan-tcc**—Virtual LAN (VLAN) translational cross-connect
  - **extended-vlan-ccc**—Standard Tag Protocol Identifier (TPID) tagging for a cross-connect
  - **ethernet-vpls**—Ethernet virtual private LAN service
  - **vlan-vpls**—VLAN virtual private LAN service
  - **flexible-ethernet-services**—Allows per-unit Ethernet encapsulation configuration
- WAN PHY features, such as the following:
  - WAN PHY mode on a per-port basis
  - Insertion and detection of path trace messages
  - Ethernet WAN Interface Sublayer (WIS) object



**NOTE:** The T4000 Core Router supports only LAN PHY mode in Junos OS Release 12.1R1. Starting with Junos OS Release 12.1R2, WAN PHY mode is supported on the T4000 routers with the 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP). Starting with Junos OS Release 12.2, WAN PHY mode is supported on the T4000 routers with the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP).

---

- Single, stacked, and flexible VLAN tagging modes
- Native VLAN configuration to allow untagged frames to be received on the tagged interfaces
- Maximum transmission unit (MTU) size of up to 9192 bytes for Ethernet frames
- Link aggregation group (LAG) on single chassis
- Interoperability with other 10-Gigabit Ethernet PICs in M Series and T Series routers in the LAN PHY and WAN PHY modes
- Interrupt-driven link-down detection mechanism
- Two-to-one oversubscription of traffic across a port group

Traffic from 10 ingress ports to the Packet Forwarding Engine traffic is statically mapped to one of the 5 egress ports. 10 Gbps of bandwidth toward the Packet Forwarding Engine is shared by two ingress ports (called a *port group*), thereby achieving two-to-one oversubscription. This scheme provides two-to-one oversubscription across a port group and not across the entire PIC.

- Four queues per physical interface on ingress and eight queues per physical interface on egress
- A separate control queue per physical interface to ensure that the control packets are not dropped during oversubscribed traffic. The control queue can be disabled in the CLI.
- Optical diagnostics
- Behavior aggregate (BA) classification (IPv4 DSCP, IPv6 DSCP, Inet precedence, IEEE 802.1P, IEEE 802.1AD, MPLS EXP) and fixed classification
- Weighted round-robin scheduling with two queue priorities (low and strict-high)
- Committed information rate and peak information rate shaping on a per-queue basis
- Excess information rate configuration for allocation of excess bandwidth
- IEEE 802.3ah Operation, Administration, and Maintenance (OAM)-related operations, such as the following:
  - Link fault management
  - Link discovery
  - Graceful Routing Engine Switchover
- IEEE 802.3ag Operation, Administration, and Maintenance (OAM)-related operations, such as the following:
  - Connectivity fault management (CFM)
  - Linktrace
  - Loopback
  - Graceful Routing Engine switchover (GRES)

The 10-port 10-Gigabit Ethernet LAN/WAN PIC has the following caveats:

- Source address and destination address MAC filtering takes place after oversubscription is handled.
- Oversubscription on the PIC operates across a port group of two ports and not at the PIC level.
- Queuing is not supported at the logical interface level.
- Committed information rate and peak information rate configurations are not supported at the physical interface level.
- There is limited packet buffering of 2 MB.
- Delay-bandwidth buffering configuration is not supported.
- Multifield classifiers are not supported at the PIC level.

The multifield classification can be done at the Packet Forwarding Engine using the firewall filters, which overrides the classification done at the PIC level. The multifield

classification at the Packet Forwarding Engine occurs after the PIC handles the oversubscribed traffic.

- Egress MAC policer statistics not supported.
- Byte counters are not supported at the queue level.
- Only TPID (0x8100) is supported.
- Line-timing mode is not supported.
- MAC-level Rx VLAN tagged frames counter is not supported.
- OAM unified in-service software upgrade (unified ISSU) is not supported.
- OAM remote loopback is not supported.

The 10-port 10-Gigabit Ethernet LAN/WAN PIC (PD-5-10XGE-SFPP) supports link aggregation. For bandwidth aggregation, load sharing, and link protection, LAG can be enabled. Once aggregated Ethernet is enabled, Link Aggregation Control Protocol (LACP) forms an aggregated bundle of member links.

Only features that are supported across all of the linked devices will be supported in the resulting LAG bundle. The following caveats apply to LAG bundles that involve 10-port 10-Gigabit Ethernet LAN/WAN PIC (PD-5-10XGE-SFPP) ports:

- Non-standard TPID for VLAN tagging is not supported, except for 0x8100.
- The number of user created IFLs is limited to 4065/PIC and 1022/port.
- Classifier tables are limited to 8 for each BA classifier type.
- Forwarding classes are limited to 8.
- The **guaranteed-rate** and **shaping-rate** statements are not supported at the IFD level.
- The **per-unit-scheduler** and **hierarchical-scheduler** statements are not supported.
- Only the **strict-high** and **low** levels of scheduling priorities are supported.
- The **excess-priority** configuration is not supported.
- The **buffer-size** configuration under **schedulers** is not supported.
- WRED is not supported.
- srTCM and trTCM are not supported.
- Shared scheduler mode is not supported.

[Table 23 on page 360](#) 10-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP).

**Table 23: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs**

Capability	Support
Maximum VLANs per PIC	4065
Maximum VLANs per port	1022

Table 23: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs (*continued*)

Capability	Support
MAC learning per port	960
MAC accounting per port	960
MAC filtering per port	960 (64 filters per physical or logical interface) 960 filters across multiple logical interfaces
MAC policers	128 ingress Mac policers 128 egress Mac policers
Classifiers	Eight classifiers per PIC for each BA classifier type

**Related Documentation**

- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 365](#)
- [Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 366](#)
- [Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 369](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## 12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview

The 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC is a 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number, PF-12XGE-SFPP) on T4000 Core Routers.

The following features are supported on the 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC:

- Access to all 10-Gigabit Ethernet port counters through SNMP.
- Logical interface–level MAC filtering, accounting, policing, and learning for source media access control (MAC).
- Flexible encapsulation.
- Single, stacked, and flexible VLAN tagging modes.
- Native VLAN configuration to allow untagged frames to be received on the tagged interfaces.
- Maximum transmission unit (MTU) size of up to 9192 bytes for Ethernet frames.

- Link aggregation group (LAG) on single chassis.
- Interoperability with other 10-Gigabit Ethernet PICs on M Series and T Series routers in LAN PHY mode.
- Eight queues per physical interface on egress.
- Behavior aggregate (BA) classification (IPv4 DSCP, IPv6 DSCP, Inet precedence, IEEE 802.1P, IEEE 802.1AD, MPLS EXP) and fixed classification.
- Defining the VLAN rewrite operation to be applied to the incoming and outgoing frames on logical interfaces on this PIC.



**NOTE:** Only the Tag Protocol Identifier (TPID) 0x8100 is supported.

- Interface encapsulations, such as the following:
  - **untagged**—Default encapsulation, when other encapsulation is not configured.
    - You can configure only one logical interface (unit 0) on the port.
    - You cannot include the **vlan-id** statement in the configuration of the logical interface.
  - **vlan-tagging**—Enable VLAN tagging for all logical interfaces on the physical interface.
  - **stacked-vlan-tagging**—Enable stacked VLAN tagging for all logical interfaces on the physical interface.
  - **ethernet-ccc**—Ethernet cross-connect.
  - **ethernet-tcc**—Ethernet translational cross-connect.
  - **vlan-ccc**—802.1Q tagging for a cross-connect.
  - **vlan-tcc**—Virtual LAN (VLAN) translational cross-connect.
  - **extended-vlan-ccc**—Standard Tag Protocol Identifier (TPID) tagging for a cross-connect.
  - **extended-vlan-tcc**—Standard Tag Protocol Identifier (TPID) tagging for an Ethernet translational cross-connect.
  - **ethernet-vpls**—Ethernet virtual private LAN service.
  - **vlan-vpls**—VLAN virtual private LAN service.
  - **flexible-ethernet-services**—Allows per-unit Ethernet encapsulation configuration.
- The following Layer 3 protocols are also supported:
  - IPv4
  - IPv6
  - MPLS
- WAN PHY features, such as the following:

- WAN PHY mode on a per-port basis.
- Insertion and detection of path trace messages.
- Ethernet WAN Interface Sublayer (WIS) object.



**NOTE:** The T4000 Core Router supports only LAN PHY mode in Junos OS Release 12.1R1. Starting with Junos OS Release 12.1R2, WAN PHY mode is supported on T4000 routers with 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+.

The 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC does not support:

- MAC filtering, accounting, and policing for destination MAC at the logical interface level.



**NOTE:** Because destination MAC filtering is not supported, the hardware is configured to accept all the multicast packets. This enables the OSPF protocol to work.

- Premium MAC policers at the logical interface level.
- MAC filtering, accounting, and policing at the physical interface level.
- Multiple TPIDs

Capability	Support
Maximum logical interfaces per PIC	32,000
Maximum logical interfaces per port	For IPv4 the limit is 4093. For IPv6 the limit is 1022.
Classifiers	Eight classifiers per PIC for each BA classifier type

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357](#)

**24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview**

This section describes the main features and caveats of the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PF-24XGE-SFPP).

The following major software features are supported on the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PF-24XGE-SFPP):

- Twenty-four 10-Gigabit Ethernet interfaces in two-to-one oversubscription of traffic in oversubscribed mode or 12 ports in line-rate mode. For more information about oversubscribed mode and line-rate mode, see the [“Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription” on page 365](#).
- Traffic is classified as control traffic or best-effort traffic with non-class-of-service-aware tail drops of best-effort traffic in oversubscribed mode.

The aggregate bandwidth of all the ports together is 120 Gbps. No hard partitioning of bandwidth is done—that is, if one port group is active, it can support 120 Gbps traffic. The bandwidth for best-effort traffic is shared among all the 24 ports.

Note that the preclassification is restricted to two traffic classes, and is not user-configurable.

- All Junos OS configuration commands supported on the existing 10-Gigabit Ethernet LAN/WAN PIC with SFP+.
- The output of the **show interfaces extensive** operational mode command now displays preclassification queue counters.
- Line-rate mode operation of the first 12 ports can be achieved by using the **[set chassis fpc fpc-number pic pic-number linerate-mode]** command. By default, the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ works in oversubscribed mode.
- LAN PHY mode and WAN PHY mode on a per-port basis. WAN PHY mode can be achieved by using the **[set interfaces interface-name framing wan-phy]** command.
- WAN PHY features, such as the following:
  - Insertion and detection of path trace messages.
  - Ethernet WAN Interface Sublayer (WIS) object.
- Aggregated Ethernet is supported only in line-rate mode.
- Link aggregation group (LAG) is supported only in line-rate mode.
- 4000 logical interfaces per physical interface and 32,000 logical interfaces per chassis.
- Access to all 10-Gigabit Ethernet port counters through SNMP.



**NOTE:** Graceful Routing Engine switchover (GRES) and nonstop active routing (NSR) are now supported on T4000 routers.

---

#### Related Documentation

- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 361](#)
- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 365](#)



## Modes of Operation of 10-Gigabit Ethernet PICs

10-Gigabit Ethernet PICs operate in the following modes:

- **Line-rate mode**—By default, the 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP) operates in line-rate mode.

In a 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP), 12 ports (ports 0–11) can operate in line-rate mode. To configure the PF-24XGE-SFPP PIC to operate in line-rate mode, include the **linerate-mode** statement at the **[edit chassis set fpc fpc-number pic pic-number]** hierarchy level.

- **Oversubscribed mode**—In this mode, all ports on the PIC are enabled with two-to-one oversubscription. In a PF-24XGE-SFPP PIC, by default, two-to-one oversubscription of traffic is achieved in oversubscribed mode—Traffic from 24 ingress ports to the Packet Forwarding Engine is statically mapped to one of the 12 egress ports. 10 Gbps of bandwidth traffic moving toward the Packet Forwarding Engine is shared by two ingress ports (called a port group), thereby achieving two-to-one oversubscription. This scheme provides two-to-one oversubscription across a port group and not across the entire PIC.



**NOTE:** PF-12XGE-SFPP PIC always operates at line rate.

- **Mixed-rate mode or dual-rate mode**—Dual-rate mode or mixed-rate mode for PF-24XGE-SFPP allows you to configure a mix of port speeds of 1 Gbps and 10 Gbps. However, on PF-12XGE-SFPP, note that you can configure port speeds of either 1 Gbps and 10 Gbps when the PIC is in line rate mode. You can enable mixed-rate mode and set port speeds with the **mixed-rate-mode** and **speed 1G |10G** statements respectively at the **[edit chassis fpc x pic y]** hierarchy level. You can disable mixed-rate mode with the **delete chassis fpc x pic y mixed-rate-mode** statement.



**NOTE:** To change the port speed from 10 Gbps to 1 Gbps on the PF-24XGE-SFPP and PF-12XGE-SFPP PICs, SFP optics is required.

### Related Documentation

- [Configuring Mixed-Rate Mode Operation on page 370](#)
- [mixed-rate-mode on page 1067](#)

## Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription

For 10-Gigabit Ethernet LAN/WAN PICs supporting oversubscription, oversubscribed Ethernet mode is set by default. To configure these PICs in line-rate mode, include the **linerate-mode** statement at the **[edit chassis set fpc fpc-number pic pic-number]** hierarchy level:

```
[edit chassis]
set fpc fpc-number pic pic-number linerate-mode;
```

To return to the default oversubscribed Ethernet mode, delete the **linerate-mode** statement at the **[edit chassis fpc *fpc-number* pic *pic-number*]** hierarchy level.



**NOTE:** When the mode of operation of a PIC is changed, the PIC is taken offline and then brought back online immediately.

The following 10-Gigabit Ethernet LAN/WAN PICs support line-rate mode:

- 10-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PD-5-10XGE-SFPP)
- 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PF-24XGE-SFPP)

**Related  
Documentation**

- [10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357](#)
- [24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 363](#)
- [Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 366](#)
- [Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 369](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC

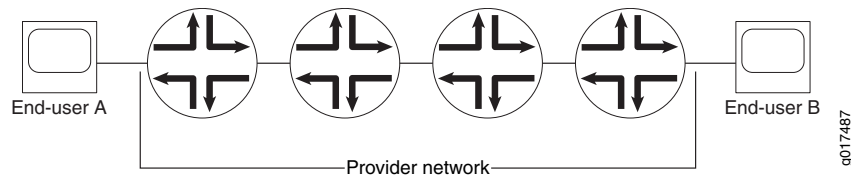
On a 10-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PD-5-10XGE-SFPP), a control queue is used to queue all control packets received on an ingress port. This ensures that control protocol packets do not get dropped randomly when there is congestion due to oversubscription. The following control protocols are supported:

- OSPF
- OSPF3
- VRRP
- IGMP
- RSVP
- PIM
- BGP
- BFD
- LDP
- IS-IS
- RIP

- RIPV6
- LACP
- ARP
- IPv6 NDP
- Connectivity fault management (CFM)
- Link fault management (LFM)

These control packets can either terminate locally or transit through the router. The control queue has a rate limiter to limit the control traffic to 2 Mbps (fixed, not user-configurable) per port. Hence, if transit control traffic is taking too much bandwidth, then it can cause drops on locally terminating control traffic, as shown in [Figure 26 on page 367](#).

**Figure 26: Control Queue Rate Limiter Scenario**



If the end users generate a mass of malicious traffic for which the port number is 179 (BGP), the router dispatches that traffic to the ingress control queue. Further, if congestion occurs in this ingress control queue due to this malicious traffic, the provider's network control packets may be affected.

In some applications, this can be perceived as a new vulnerability. To address this concern, you can disable the control queue feature. With the control queue feature disabled, you must take precautions to protect control traffic through other means, such as mapping control packets (using BA classification) to a queue that is marked strict-high or is configured with a high CIR.

You can disable the control queue for all ports on the PIC. To disable the control queue, use the **set chassis fpc *n* pic *n* no-pre-classifier** command. By default, the **no-pre-classifier** statement is not configured and the control queue is operational.

Deleting the **no-pre-classifier** statement re-enables the control queue feature on all ports of the 10-Gigabit Ethernet LAN/WAN PIC.

**NOTE:**

- This functionality is applicable both in OSE and line-rate modes.
- The control queue feature is enabled by default in both OSE and line-rate modes, which can be overridden by the user configuration.
- When the control queue is disabled, various **show queue** commands will show *control queue* in the output. However, all control queue counters are reported as zeros.
- Changing this configuration (enabling or disabling the control queue feature) results in the PIC being taken offline and brought back online.

Once the control queue is disabled, the Layer 2/Layer 3 control packets are subject to queue selection based on BA classification. However, some control protocol packets will not be classified using BA classification, because they might not have a VLAN, MPLS, or IP header. These are:

- Untagged ARP packets
- Untagged Layer 2 control packets such as LACP or Ethernet OAM
- Untagged IS-IS packets

When the control queue feature is disabled, untagged ARP, IS-IS, and other untagged Layer 2 control packets will go to the restricted queue corresponding to the forwarding class associated with queue 0, as shown in the following two examples.

#### Forwarding Untagged Layer2 Control Packets to Queue 3

With this configuration, the forwarding class (FC) associated with queue 0 is "be" (based on the **forwarding-class** statement configuration). "be" maps to restricted-queue number 3 (based on the "restricted-queue" configuration). Hence, with this particular configuration, untagged ARP, IS-IS, and other untagged Layer 2 control packets will go to ingress queue 3 (not to ingress queue 0).

```
[edit chassis]
forwarding-classes {
  queue 0 be;
  queue 1 af-low8;
  queue 2 af-high;
  queue 3 ef;
  queue 4 ops_control;
  queue 5 net_control;
  queue 6 af-low10_12;
}
restricted-queues {
  forwarding-class ef queue-num 0;
  forwarding-class af-low8 queue-num 1;
  forwarding-class af-low10_12 queue-num 1;
  forwarding-class af-high queue-num 2;
  forwarding-class be queue-num 3;
}
```

**Forwarding Untagged Layer2 Control Packets to Queue 3**

With this configuration, the FC associated with queue 0 is "ef" (based on the **forwarding-class** statement configuration). "ef" maps to restricted-queue number 0 (based on the **restricted-queue** statement configuration). Hence, with this particular configuration, untagged ARP, IS-IS, and other untagged Layer 2 control packets would go to ingress queue 0.

For tagged ARP, IS-IS, or Layer2 control packets, users should configure an explicit dot1p/dot1ad classifier to make sure these packets are directed to the correct queue. Without an explicit dot1p/dot1ad classifier, tagged ARP, IS-IS, or Layer 2 control packets will go to the restricted-queue corresponding to the forwarding class associated with queue 0.

```
[edit chassis]
forwarding-classes {
  queue 0 ef; <<< ef and be are interchanged
  queue 1 af-low8;
  queue 2 af-high;
  queue 3 be; <<< ef and be are interchanged
  queue 4 ops_control;
  queue 5 net_control;
  queue 6 af-low10_12;
}
restricted-queues {
  forwarding-class ef queue-num 0;
  forwarding-class af-low8 queue-num 1;
  forwarding-class af-low10_12 queue-num 1;
  forwarding-class af-high queue-num 2;
  forwarding-class be queue-num 3;
}
```

**Related Documentation**

- [10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357](#)
- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 365](#)
- [no-pre-classifier on page 1084](#)
- [Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 369](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

**Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC**

Table 24 on page 370 lists the scenarios of handling oversubscription on the 10-port 10-Gigabit Ethernet LAN/WAN PIC for different combinations of port groups and active ports on the PIC.

Table 24: Handling Oversubscription on 10-Gigabit Ethernet LAN/WAN PICs

Number of Port Groups with Two Active Ports (A)	Number of Port Groups with One Active Port (B)	Total Number of Ports Used on PIC (C = A x 2 + B)	Status of Oversubscription and Throughput
0	1	1	Oversubscription is not active. Each port will receive 10 Gbps throughput.
0	2	2	Oversubscription is not active. Each port will receive 10 Gbps throughput.
0	5	5	Oversubscription is not active. Each port will receive 10 Gbps throughput.
1	0	2	Oversubscription is active. Each port will receive 5 Gbps throughput (with default shaper configuration).
1	4	6	Oversubscription is active for the port group that has two active ports. Each port in this port group will receive 5 Gbps throughput (with default shaper configuration).  For the remaining four ports, oversubscription is not active. Each port will receive 10 Gbps throughput.
3	0	6	Oversubscription is active. Each port will receive 5 Gbps throughput (with default shaper configuration).
5	0	10	Oversubscription is active on all 10 ports (5 port groups). Each port will receive 5 Gbps throughput (with default shaper configuration).

#### Related Documentation

- [10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357](#)
- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 365](#)
- [Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 366](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Mixed-Rate Mode Operation

To configure mixed-rate mode operation for a PF-24XGE-SFPP PIC:

1. Navigate to the **[edit chassis]** hierarchy level.
2. On a T4000 router, configure the mixed-rate mode by including the **mixed-rate-mode** statement at the **[edit chassis fpc slot-number pic pic-number]** hierarchy level.

```
[edit chassis]
user@host# set fpc fpc-slot pic pic-number mixed-rate-mode
```

On an LCC in a routing matrix, configure the mixed-rate mode by including the **mixed-rate-mode** statement at the **[edit chassis lcc lcc-number fpc slot-number pic pic-number]** hierarchy level.

```
[edit chassis]
user@host# set lcc lcc-number fpc fpc-slot pic pic-number mixed-rate-mode
```

3. Specify the port and the port speed that need to be configured. You can use one of the following speed attributes for this configuration.

```
[edit chassis]
user@host# set fpc fpc-slot pic pic-number port port-number speed 1G;
user@host# set fpc fpc-slot pic pic-number port port-number speed 10G;
user@host# set lcc lcc-number fpc fpc-slot pic pic-number speed 1G;
user@host# set lcc lcc-number fpc fpc-slot pic pic-number speed 10G;
```



**NOTE:** On a 12 port 10-Gigabit Ethernet PIC (PF-12XGE-SFPP), you can configure the port speed as 1G by including the **set fpc fpc-slot pic pic-number port port-number speed 1G** statement at the **[edit chassis]** hierarchy level.



**NOTE:** To change the port speed from 10 Gbps to 1 Gbps on PF-24XGE-SFPP and PF-12XGE-SFPP PICs, SFP optics is required.

To disable mixed-rate mode operation, include the **delete chassis fpc x pic y mixed-rate-mode** statement at the **[edit chassis]** hierarchy level.

#### Related Documentation

- [Modes of Operation of 10-Gigabit Ethernet PICs on page 365](#)
- [mixed-rate-mode on page 1067](#)

## P2-10G-40G-QSFPP PIC Overview

Starting with Junos OS Release 14.1R2 and 14.2R1, PTX5000 supports the P2-10G-40G-QSFPP PIC on the FPC2-PTX-P1A FPC.

All the ports on the P2-10G-40G-QSFPP PIC are plugged into quad small form-factor pluggable plus transceivers (QSFP+) that, in turn, are connected to fiber-optic cables that support both 10-Gigabit Ethernet standards and 40-Gigabit Ethernet standards, thereby enabling you to configure the PIC to operate either in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode.

Starting from Junos OS Release 15.1, you can perform the following on the P2-10G-40G-QSFPP PIC on PTX5000 routers:

- You can configure the interfaces on this PIC to be a part of the mixed rates and mixed mode aggregated Ethernet bundles. For information about mixed rates, see [“Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles” on page 129](#).

- Port-based pseudowire class of service (CoS) classification which includes Layer 3 IPv4, IPv6, and MPLS classification for interfaces with ethernet-ccc encapsulation.

The following sections describe the P2-10G-40G-QSFPP PIC and the various framing modes that are supported on it:

- [Understanding Dual Configuration on P2-10G-40G-QSFPP PIC on page 372](#)
- [Port Numbering on P2-10G-40G-QSFPP PIC on page 373](#)
- [10-Gigabit Ethernet Mode on page 374](#)
- [40-Gigabit Ethernet Mode on page 375](#)

## Understanding Dual Configuration on P2-10G-40G-QSFPP PIC

All the ports on the P2-10G-40G-QSFPP PIC are QSFP+ based—that is, all the ports are connected to fiber-optic cables by means of QSFP+ transceivers.

The QSFP+ module—which includes the transceiver and the fiber-optic cable—supports the following standards on the P2-10G-40G-QSFPP PIC:

- 10-Gigabit Ethernet in LAN PHY framing mode (also known as native Ethernet mode) and WAN PHY framing mode.
- 40-Gigabit Ethernet in LAN PHY framing mode.

The P2-10G-40G-QSFPP PIC provides forty-eight 10-Gigabit Ethernet ports or twelve 40-Gigabit Ethernet ports. The PIC can be configured either in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode with the **set chassis fpc *fpc-number* pic *pic-number* pic-mode (10G | 40G)** configuration command. By default, the PIC is configured in 10-Gigabit Ethernet LAN PHY framing mode.



### NOTE:

If you want configure the PIC in 10-Gigabit Ethernet mode to operate in 40-Gigabit Ethernet mode, you must:

1. Delete all the interfaces in the PIC at the [edit interfaces] hierarchy level.
2. Configure the PIC to operate in 40-Gigabit Ethernet mode by using the **set chassis fpc *fpc-slot* pic *pic-slot* pic-mode 40G** configuration command and commit.

The PIC reboots and starts operating in the new mode.

The same procedure is applicable when you can configure the PIC in 40-Gigabit Ethernet PIC to operate in 10-Gigabit Ethernet mode. In this case, you must execute the **set chassis fpc *fpc-slot* pic *pic-slot* pic-mode 10G** configuration mode command.

---

To check the current diagnostics of the PIC, you must run the relevant operational mode CLI commands such as **show chassis hardware**, **show interfaces**, **show interfaces diagnostics optics *interface-name***, and so on.



## Port Numbering on P2-10G-40G-QSFP PIC

Table 25 on page 373 shows the port numbering in 40-Gigabit Ethernet mode and in 10-Gigabit Ethernet mode.

**Table 25: Port Numbering Table**

QSFP+ Port Number	Port Numbering in 40-Gigabit Ethernet Mode	Port Numbering in 10-Gigabit Ethernet Mode
0	et-1/1/0	et-1/1/0:0
		et-1/1/0:1
		et-1/1/0:2
		et-1/1/0:3
1	et-1/1/1	et-1/1/1:0
		et-1/1/1:1
		et-1/1/1:2
		et-1/1/1:3
2	et-1/1/2	et-1/1/2:0
		et-1/1/2:1
		et-1/1/2:2
		et-1/1/2:3
3	et-1/1/3	et-1/1/3:0
		et-1/1/3:1
		et-1/1/3:2
		et-1/1/3:3
4	et-1/1/4	et-1/1/4:0
		et-1/1/4:1
		et-1/1/4:2
		et-1/1/4:3
5	et-1/1/5	et-1/1/5:0
		et-1/1/5:1
		et-1/1/5:2
		et-1/1/5:3

Table 25: Port Numbering Table (*continued*)

QSFP+ Port Number	Port Numbering in 40-Gigabit Ethernet Mode	Port Numbering in 10-Gigabit Ethernet Mode
6	et-1/1/6	et-1/1/6:0
		et-1/1/6:1
		et-1/1/6:2
		et-1/1/6:3
7	et-1/1/7	et-1/1/7:0
		et-1/1/7:1
		et-1/1/7:2
		et-1/1/7:3
8	et-1/1/8	et-1/1/8:0
		et-1/1/8:1
		et-1/1/8:2
		et-1/1/8:3
9	et-1/1/9	et-1/1/9:0
		et-1/1/9:1
		et-1/1/9:2
		et-1/1/9:3
10	et-1/1/10	et-1/1/10:0
		et-1/1/10:1
		et-1/1/10:2
		et-1/1/10:3
11	et-1/1/11	et-1/1/11:0
		et-1/1/11:1
		et-1/1/11:2
		et-1/1/11:3

## 10-Gigabit Ethernet Mode

A 10-Gigabit Ethernet interface can operate in 10-Gigabit Ethernet LAN PHY framing mode or 10-Gigabit Ethernet WAN PHY framing mode.

You can configure a 10-Gigabit Ethernet interface at the **[edit interface *interface-name* framing-mode (lan-phy | wan-phy)]** hierarchy level to operate in 10-Gigabit Ethernet LAN PHY framing mode or in 10-Gigabit Ethernet WAN PHY framing mode.

Each P2-10G-40G-QSFPP PIC provides 48 physical interfaces. The interfaces are represented by the *et-fpc/pic/QSFP+ port:channel* interface naming convention, where the value of the *QSFP+ port* option ranges from 0 through 11 and the value of the *channel* option ranges from 0 through 3.

When a P2-10G-40G-QSFPP PIC is configured in 10-Gigabit Ethernet framing mode, it can operate in one of the following framing modes:

- LAN PHY framing mode. Note that by default, the PIC is in 10-Gigabit Ethernet LAN PHY framing mode.



**NOTE:** The ports are set to LAN PHY framing mode by default when the **framing-mode** statement is not configured at the **[edit interface *interface-name*]** hierarchy level.

- WAN PHY framing mode

## 40-Gigabit Ethernet Mode

You can configure twelve 40-Gigabit Ethernet interfaces that operate in LAN PHY framing mode. The interfaces are represented by the *et-fpc/pic/QSFP+ port* interface naming convention, where the value of the *QSFP+ port* option ranges from 0 through 11.

### Related Documentation

- [Configuring the P2-10G-40G-QSFPP PIC on page 375](#)

## Configuring the P2-10G-40G-QSFPP PIC

Starting with Junos OS Release 14.1R2, PTX5000 supports the P2-10G-40G-QSFPP PIC on the FPC2-PTX-P1A FPC. You can configure the P2-10G-40G-QSFPP PIC to operate either in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode.

The following tasks explain how to configure the P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode and to configure the framing modes on it.

- [Configuring the PIC in 10-Gigabit Ethernet Mode or in 40-Gigabit Ethernet Mode on page 376](#)
- [Configuring the PIC in 10-Gigabit Ethernet Mode to Operate in 40-Gigabit Ethernet Mode on page 376](#)
- [Configuring the PIC in 40-Gigabit Ethernet Mode to Operate in 10-Gigabit Ethernet Mode on page 376](#)
- [Configuring Framing Mode on page 377](#)

## Configuring the PIC in 10-Gigabit Ethernet Mode or in 40-Gigabit Ethernet Mode

To configure the P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode:

1. In configuration mode, go to the **[edit chassis]** hierarchy level.

```
[edit]
user@host# edit chassis
```

2. Configure the PIC in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode after specifying the required FPC slot and PIC slot. Note that all the PIC ports in a PIC are configured at once with this configuration command.

```
[edit chassis]
user@host# set fpc fpc-slot pic pic-slot pic-mode (10G | 40G)
```

## Configuring the PIC in 10-Gigabit Ethernet Mode to Operate in 40-Gigabit Ethernet Mode

To configure the P2-10G-40G-QSFPP PIC that is configured in 10-Gigabit Ethernet mode to operate in 40-Gigabit Ethernet mode:

1. In configuration mode, go to the **[edit interfaces]** hierarchy level.

```
[edit]
user@host# edit interfaces
```

2. Delete all the interfaces in the PIC, commit, and then move to the top of the hierarchy level.

```
[edit interfaces]
user@host# delete interface-name
user@host# delete ...
user@host# commit
user@host# top
```

3. Configure the PIC to operate in 40-Gigabit Ethernet mode and commit.

```
[edit]
user@host# set chassis fpc fpc-slot pic pic-slot pic-mode 40G
user@host# commit
```

After the configuration is committed, the PIC reboots and starts operating in the 40-Gigabit Ethernet mode. You can now configure the parameters, such as encapsulation, framing mode, and so on, for the twelve 40-Gigabit Ethernet interfaces in the PIC as needed.

## Configuring the PIC in 40-Gigabit Ethernet Mode to Operate in 10-Gigabit Ethernet Mode

To configure the P2-10G-40G-QSFPP PIC that is configured in 40-Gigabit Ethernet mode to operate in 10-Gigabit Ethernet mode:

1. In configuration mode, go to the **[edit interfaces *interfaces-name*]** hierarchy level.

```
[edit]
user@host# edit interfaces interface-name
```

2. Delete all the interfaces in the PIC, commit, and then move to the top of the hierarchy level.

```
[edit interfaces]
user@host# delete interface-name
user@host# delete ...
user@host# commit
user@host# top
```

3. Configure the PIC to operate in 10-Gigabit Ethernet mode and commit.

```
[edit]
user@host# set chassis fpc fpc-slot pic pic-slot pic-mode 10G
user@host# commit
```

After the configuration is committed, the PIC reboots and starts operating in the 10-Gigabit Ethernet mode. You can now configure the parameters, such as encapsulation, framing mode, and so on, for the forty-eight 10-Gigabit Ethernet interfaces in the PIC as needed.

## Configuring Framing Mode

To configure the P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet mode to operate in LAN PHY framing mode or in WAN PHY framing mode, you must configure the framing mode individually on all the interfaces:

1. In configuration mode, go to the **[edit interfaces *interfaces-name*]** hierarchy level, where the interface name is in *et-fpc/pic/port:channel* format.

```
[edit]
user@host# edit interfaces interface-name
```

2. Configure the framing mode as LAN PHY or WAN PHY and commit.

```
[edit interfaces interface-name]
user@host# set framing (lan-phy | wan-phy)
user@host# commit
```

For example, you can configure the framing mode as LAN PHY or WAN PHY on the *et-1/1/1:0* interface.

To configure the P2-10G-40G-QSFPP PIC in 40-Gigabit Ethernet mode to operate in LAN PHY framing mode:

1. In configuration mode, go to the **[edit interfaces *interfaces-name*]** hierarchy level, where the interface name is in *et-fpc/pic/port* format.

```
[edit]
user@host# edit interfaces interface-name
```

2. Configure the framing mode as LAN PHY and commit.

```
[edit interfaces interface-name]
user@host# set framing (lan-phy)
user@host# commit
```

For example, you can configure the framing mode as LAN PHY on the *et-2/2/2* interface.

- Related Documentation**
- [P2-10G-40G-QSFPP PIC Overview on page 371](#)

---

## Example: Configuring the P2-10G-40G-QSFPP PIC

---

- [Requirements on page 378](#)
- [Overview on page 378](#)
- [Configuration on page 378](#)

### Requirements

This example uses the following hardware and software components:

- Junos OS Release 14.1R2 or Junos OS Release 14.2 or later
- One PTX5000 router with P2-10G-40G-QSFPP PIC

### Overview

Starting with Junos OS Release 14.1R2 and 14.2R1, PTX5000 supports the P2-10G-40G-QSFPP PIC on the FPC2-PTX-P1A FPC.

All the ports on the P2-10G-40G-QSFPP PIC are QSFP+ based—that is, all the ports are connected to fiber-optic cables by means of QSFP+ transceivers. The P2-10G-40G-QSFPP PIC provides forty-eight 10-Gigabit Ethernet ports or twelve 40-Gigabit Ethernet ports.

The QSFP+ module—which includes the transceiver and the fiber-optic cable—supports the following standards on the P2-10G-40G-QSFPP PIC:

- 10-Gigabit Ethernet in LAN PHY framing mode (also known as native Ethernet mode) and WAN PHY framing mode.
- 40-Gigabit Ethernet in LAN PHY framing mode.

### Configuration

To configure the P2-10G-40G-QSFPP PIC to operate in 10-Gigabit Ethernet mode, and to set the framing mode and other options on an interface on this PIC, perform the following tasks:

- [Configuring the P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet Mode on page 378](#)
- [Configuring the Framing Mode on an Interface on page 379](#)
- [Configuring the Interface Options on page 379](#)
- [Verification on page 380](#)

---

#### Configuring the P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet Mode

---

##### Step-by-Step Procedure

Configure the PIC in 10-Gigabit Ethernet mode.

1. In configuration mode, go to the **[edit chassis]** hierarchy level.  
**[edit]**

```
user@host# edit chassis
```

2. Configure the PIC in 10-Gigabit Ethernet mode after specifying the required FPC slot and PIC slot. Note that the PIC restarts after the configuration is committed and all the ports in the PIC come up in the 10-Gigabit Ethernet mode.

```
[edit chassis]
user@host# set fpc 1 pic 1 pic-mode 10G
```

### Configuring the Framing Mode on an Interface

**Step-by-Step Procedure** To configure an interface *et-1/1/1:0* in the P2-10G-40G-QSFPP PIC to operate in LAN PHY framing mode:

1. In configuration mode, go to the **[edit interfaces et-1/1/1:0]** hierarchy level.

```
[edit]
user@host# edit interfaces et-1/1/1:0
```

2. Configure the framing mode for the interface as LAN PHY and commit.

```
[edit interfaces et-1/1/1:0]
user@host# set framing lan-phy
user@host# commit
```

Similarly, you can configure LAN PHY or WAN PHY framing mode for the other interfaces in the PIC.

### Configuring the Interface Options

**Step-by-Step Procedure** Configure the interface options for the interface *et-1/1/1:0* as needed. The following procedure configures a few interface-specific options.

1. In configuration mode, go to the **[edit interfaces et-1/1/1:0]** hierarchy level.

```
[edit]
user@host# edit interfaces et-1/1/1:0
```

2. Configure the encapsulation as ethernet-ccc.

```
[edit interfaces et-1/1/1:0]
user@host# set encapsulation ethernet-ccc
```

3. Configure the family as CCC for the logical interface 0.

```
[edit interfaces et-1/1/1:0]
user@host# set unit 0 family ccc
```

4. Enable flow control to regulate the flow of packets from the router to the remote side of the network connection.

```
[edit interfaces et-1/1/1:0 gige-eth-options]
user@host# set flow-control
```

5. Enable loopback mode for the interface, commit the configuration, and exit the configuration mode.

```
[edit interfaces et-1/1/1:0 gige-eth-options]
user@host# set loopback
```

```
user@host# commit
user@host# quit
```

## Verification

---

### *Displaying Interface Details*

**Purpose** To display interface-specific details of the et-1/1/1:0 interface.

**Action** Execute the **show interfaces et-1/1/1:0** operational command.

```
user@host# run show interfaces et-1/1/1:0
Interface index: 525, SNMP ifIndex: 522
Link-level type: Ethernet, MTU: 1514, MRU: 0, LAN-PHY mode, Speed: 10Gbps, BPDU
Error:
None, MAC-REWRITE Error: None, Loopback: None, Source filtering: Disabled,
Flow control: Enabled
Device flags   : Present Running Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x4000
Link flags     : None
CoS queues     : 8 supported, 8 maximum usable queues
Current address: ac:4b:c8:f6:af:68, Hardware address: ac:4b:c8:f6:af:68
Last flapped   : 2014-07-25 02:23:56 PDT (02:16:07 ago)
Input rate     : 0 bps (0 pps)
Output rate    : 0 bps (0 pps)
Active alarms  : LINK
Active defects : LINK
PCS statistics                               Seconds
  Bit errors                                0
  Errored blocks                            1
Interface transmit statistics: Disabled
```

**Meaning** The interface details are displayed. Note that to display information for an interface in 10-Gigabit Ethernet mode for the P2-10G-40G-QSFPP PIC, you must use the *et-fpc/pic/port:channel* format.

**Related Documentation**

- [P2-10G-40G-QSFPP PIC Overview on page 371](#)



## CHAPTER 22

# Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength

- [Ethernet DWDM Interface Wavelength Overview on page 381](#)
- [Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 381](#)

## Ethernet DWDM Interface Wavelength Overview

---

Dense wavelength-division multiplexing (DWDM) interfaces are supported on 10-Gigabit Ethernet DWDM PICs, MICs, and MPCs; the 10-Gigabit Ethernet LAN/WAN OTN PIC; and the 100-Gigabit Ethernet DWDM OTN PIC. When a tunable optic transceiver is available, you can configure the DWDM interfaces with full C-band International Telecommunication Union (ITU)-Grid tunable optics, as defined in the following specifications:

- *Intel TXN13600 Optical Transceiver I2C Interface and Customer EEPROM Preliminary Specification*, July 2004.
- *I2C Reference Document for 300-Pin MSA 10G and 40G Transponder*, Edition 4, August 04, 2003.

By default, the wavelength is 1550.12 nanometers (nm), which corresponds to 193.40 terahertz (THz).

### Related Documentation

- [Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 381](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*
- [wavelength on page 1253](#)

## Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength

---

To configure the wavelength on 10-Gigabit Ethernet or 100-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) and OTN interfaces, include the **wavelength** statement at the **[edit interfaces *interface-name* optics-options]** hierarchy level:

```
[edit interfaces interface-name optics-options]  
wavelength nm;
```

To display the currently tuned wavelength and frequency for the interface, use the **show interfaces *interface-name*** operational mode command.

For interface diagnostics, issue the **show interfaces diagnostics optics *interface-name*** operational mode command.

[Table 26 on page 382](#) shows configurable wavelengths and the corresponding frequency for each configurable wavelength.

**Table 26: Wavelength-to-Frequency Conversion Matrix**

Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)
1528.38	196.15	1542.14	194.40	1556.15	192.65
1528.77	196.10	1542.54	194.35	1556.55	192.60
1529.16	196.05	1542.94	194.30	1556.96	192.55
1529.55	196.00	1543.33	194.25	1557.36	192.50
1529.94	195.95	1543.73	194.20	1557.77	192.45
1530.33	195.90	1544.13	194.15	1558.17	192.40
1530.72	195.85	1544.53	194.10	1558.58	192.35
1531.12	195.80	1544.92	194.05	1558.98	192.30
1531.51	195.75	1545.32	194.00	1559.39	192.25
1531.90	195.70	1545.72	193.95	1559.79	192.20
1532.29	195.65	1546.12	193.90	1560.20	192.15
1532.68	195.60	1546.52	193.85	1560.61	192.10
1533.07	195.55	1546.92	193.80	1561.01	192.05
1533.47	195.50	1547.32	193.75	1561.42	192.00
1533.86	195.45	1547.72	193.70	1561.83	191.95
1534.25	195.40	1548.11	193.65	1562.23	191.90
1534.64	195.35	1548.51	193.60	1562.64	191.85
1535.04	195.30	1548.91	193.55	1563.05	191.80
1535.43	195.25	1549.32	193.50	1563.45	191.75

Table 26: Wavelength-to-Frequency Conversion Matrix (*continued*)

Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)
1535.82	195.20	1549.72	193.45	1563.86	191.70
1536.22	195.15	1550.12	193.40	1564.27	191.65
1536.61	195.10	1550.52	193.35	1564.68	191.60
1537.00	195.05	1550.92	193.30	1565.09	191.55
1537.40	195.00	1551.32	193.25	1565.50	191.50
1537.79	194.95	1551.72	193.20	1565.90	191.45
1538.19	194.90	1552.12	193.15	1566.31	191.40
1538.58	194.85	1552.52	193.10	1566.72	191.35
1538.98	194.80	1552.93	193.05	1567.13	191.30
1539.37	194.75	1553.33	193.00	1567.54	191.25
1539.77	194.70	1553.73	192.95	1567.95	191.20
1540.16	194.65	1554.13	192.90	1568.36	191.15
1540.56	194.60	1554.54	192.85	1568.77	191.10
1540.95	194.55	1554.94	192.80		
1541.35	194.50	1555.34	192.75		
1541.75	194.45	1555.75	192.70		

**Related Documentation**

- [Ethernet DWDM Interface Wavelength Overview on page 381](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [wavelength on page 1253](#)



# Configuring 10-Gigabit Ethernet Framing

- [10-Gigabit Ethernet Framing Overview on page 385](#)
- [Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces on page 386](#)
- [Configuring 10-Gigabit Ethernet Framing on page 387](#)

## 10-Gigabit Ethernet Framing Overview

---

The 10-Gigabit Ethernet interfaces support operation in two modes:

- 10GBASE-R, LAN Physical Layer Device (LAN PHY)
- 10GBASE-W, WAN Physical Layer Device (WAN PHY)

When the external interface is running in LAN PHY mode, it bypasses the WIS sublayer to directly stream block-encoded Ethernet frames on a 10-Gigabit Ethernet serial interface. When the external interface is running in WAN PHY mode, it uses the WIS sublayer to transport 10-Gigabit Ethernet frames in an OC192c SONET payload.

WAN PHY mode is supported on MX240, MX480, MX960, T640, T1600, T4000 and PTX Series Packet Transport routers only.



**NOTE:** The T4000 Core Router supports only LAN PHY mode in Junos OS Release 12.1R1. Starting with Junos OS Release 12.1R2, WAN PHY mode is supported on the T4000 routers with the 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP). Starting with Junos OS Release 12.2, WAN PHY mode is supported on the T4000 routers with the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP).

Although the external interface provides a lower throughput when running in WAN PHY mode because of the extra SONET overhead, it can interoperate with SONET section or line level repeaters. This creates an advantage when the interface is used for long-distance, point-to-point 10-Gigabit Ethernet links. When the external interface is running in WAN PHY mode, some SONET options are supported. For information about SONET options supported on this interface, see *Configuring SONET Options for 10-Gigabit Ethernet Interfaces*.



**NOTE:** SONET or SDH framing mode configuration `framing (sdh | sonet)` is not applicable on the 10-Gigabit Ethernet ports. Configuring the `wan-phy` framing mode on the 10-Gigabit Ethernet ports allows the interface to accept SONET or SDH frames without further configuration.

**Related  
Documentation**

- [Configuring SONET/SDH Framing Mode for Ports](#)
- [Configuring 10-Gigabit Ethernet Framing on page 387](#)
- [Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces on page 386](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces

---

If you use the **wan-phy** statement option at the `[edit interfaces xe-fpc/pic/0 framing]` hierarchy level to configure Trio WAN mode framing for 10-Gigabit Ethernet interfaces, then the alarm behavior of the link, although in full compliance with the IEEE 802.3ae 10-Gigabit Ethernet standard, might not be as expected.

In particular:

- The interface does not distinguish between loss of light (LOL), loss of phase lock loop (PLL), or loss of signal (LOS). If a loss of PLL or LOS alarm occurs, then both PLL and LOS alarms are raised. LOL is also raised because there is no separate LOL indication from the hardware.
- The interface does not raise LOS, PLL, or LOL alarms when the fiber is disconnected from the interface port. You must remove the hardware to raise this alarm.
- The interface line-level alarm indicator signal (AIS-L) is not always raised in response to a loss of framing (LOF) defect alarm.
- If the AIS-L or path-level AIS (AIS-P) occurs, the interface path-level loss of code delineation (LCD-P) is not detected. LCD-P is seen during the path-level remote defect indicator (RDI-P) alarm.
- If an AIS-L alarm occurs, the AIS-P is not detected, but the LOP alarm is detected.

None of the alarm issues are misleading, but they make troubleshooting the root cause of problems more complex.

**Related  
Documentation**

- [framing on page 979](#)
- [Configuring 10-Gigabit Ethernet Framing on page 387](#)
- [10-Gigabit Ethernet Framing Overview on page 385](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring 10-Gigabit Ethernet Framing

The 10-Gigabit Ethernet interfaces uses the interface type **xe-fpc/pic/port**. On single port devices, the port number is always zero.

The **xe-fpc/pic/port** interface inherits all the configuration commands that are used for gigabit Ethernet (**ge-fpc/pic/port**) interfaces.

To configure LAN PHY or WAN PHY operating mode, include the **framing** statement with the **lan-phy** or **wan-phy** option at the **[edit interfaces xe-fpc /pic/0 ]** hierarchy level.

```
[edit interfaces xe-fpc/pic/0 framing]
framing (lan-phy | wan-phy);
```



### NOTE:

- The T4000 Core Router supports only LAN PHY mode in Junos OS Release 12.1R1. Starting with Junos OS Release 12.1R2, WAN PHY mode is supported on the T4000 routers with the 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP). Starting with Junos OS Release 12.2, WAN PHY mode is supported on the T4000 routers with the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP).
- On PTX Series Transport Routers, WAN PHY mode is supported only on the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+.
- When the PHY mode changes, interface traffic is disrupted because of port reinitialization.

To display interface information, use the operational mode command **show interfaces xe-fpc/pic/port extensive**.



### NOTE:

- SONET or SDH framing mode configuration **framing (sdh | sonet)** is not applicable on the 10-Gigabit Ethernet ports. Configuring the **wan-phy** framing mode on the 10-Gigabit Ethernet ports allows the interface to accept SONET or SDH frames without further configuration.
- If you configure the WAN PHY mode on an aggregated Ethernet interface, you must set the aggregated Ethernet link speed to OC192.

### Related Documentation

- [framing on page 979](#)
- [10-Gigabit Ethernet Framing Overview on page 385](#)
- [Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces on page 386](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*





# Configuring 10-Gigabit Ethernet Notification of Link Down Alarm

- [Gigabit Ethernet Notification of Link Down Alarm Overview on page 389](#)
- [10-Gigabit Ethernet Notification of Link Down for Optics Options Overview on page 389](#)
- [Configuring Gigabit Ethernet Notification of Link Down Alarm on page 390](#)
- [Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 390](#)

## Gigabit Ethernet Notification of Link Down Alarm Overview

---

Notification of link down alarm generation and transfer is supported for all 10-Gigabit Ethernet PIC interfaces on M120 and M320 routers. On the MX Series and T series routers, notification of link down alarm generation and transfer is supported for all Gigabit Ethernet Interfaces (1-Gigabit, 10-Gigabit, and 100-Gigabit).

**Related  
Documentation**

- [Configuring Gigabit Ethernet Notification of Link Down Alarm on page 390](#)
- [asynchronous-notification on page 878](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## 10-Gigabit Ethernet Notification of Link Down for Optics Options Overview

---

Notification of link down is supported for IQ2 10-Gigabit Ethernet interfaces and MX Series DPCs. You can use link down notification to help identify optical link connectivity problems.

For information on configuring link down notification, see “[Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning](#)” on page 390.

**Related  
Documentation**

- [Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 390](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Gigabit Ethernet Notification of Link Down Alarm

---

Notification of link down alarm generation and transfer is supported for all 10-Gigabit Ethernet PIC interfaces on M120 and M320 routers. On the MX Series and T Series routers, notification of link down alarm generation and transfer is supported for all Gigabit Ethernet Interfaces (1-Gigabit, 10-Gigabit, and 100-Gigabit).

To configure this option, include the **asynchronous-notification** statement at the **[edit interfaces ge- fpc/pic/port gigether-options]** hierarchy level:

```
[edit interfaces]
ge-fpc/pic/port {
  gigether-options {
    asynchronous-notification;
  }
}
```

### Related Documentation

- [Gigabit Ethernet Notification of Link Down Alarm Overview on page 389](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*
- [asynchronous-notification on page 878](#)

## Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning

---

To configure this option, include the **alarm** or **warning** statement at the **[edit interfaces ge- fpc/pic/port optics-options]** hierarchy level:

```
[edit interfaces]
ge-fpc/pic/port {
  optics-options {
    alarm alarm-name {
      (syslog | link-down);
    }
    warning warning-name {
      (syslog | link-down);
    }
  }
}
```

### Related Documentation

- [alarm on page 874](#)
- [warning on page 1252](#)
- [10-Gigabit Ethernet Notification of Link Down for Optics Options Overview on page 389](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

# Configuring 40-Gigabit Ethernet PICs

- [40-Gigabit Ethernet PIC Overview on page 391](#)
- [Configuring 40-Gigabit Ethernet PICs on page 393](#)

## 40-Gigabit Ethernet PIC Overview

---

The 40-Gigabit Ethernet PIC with CFP (PD-1XLE-CFP) is a 1-port 40-Gigabit Ethernet Type 4 PIC with C form-factor pluggable transceiver (CFP) optics supported on T640, T1600, and T4000 routers. The 40-Gigabit Ethernet PIC occupies FPC slot 0 or 1 in the Type 4 FPC and it is similar to any regular PIC such as the 4-port 10-Gigabit Ethernet LAN/WAN PIC with XFP (PD-4XGE-XFP) PIC. The CFP information appears under the PIC information in the show command output.

The 40-Gigabit Ethernet PIC with CFP supports flexible Ethernet services encapsulation and MAC accounting.

MAC learning, MAC policing, and Layer 2 rewrite features are not supported.

The 40-Gigabit Ethernet PIC with CFP supports the following features:

- Encapsulation protocols such as:
  - Layer 2 protocols
    - Ethernet CCC, Ethernet TCC, and Ethernet VPLS
    - VLAN CCC
    - Extended VLAN TCC
    - VLAN VPLS
    - Flexible Ethernet service
  - Layer 3 protocols
    - IPv4
    - IPv6

- MPLS
- CFP Multi-Source Agreement (MSA)-compliant management data input/output (MDIO) control features (transceiver dependent).
- Graceful Routing Engine switchover (GRES) (in all PIC and chassis configurations).
- Interface creation:
  - When the PIC is brought online, the router creates one interface, et-x/y/0, where x represents the FPC slot number and y represents PIC slot number. The physical interface represents internal Ethernet Packet Forwarding Engines.
  - The FPC slot number ranges from 0 through 7 in T640, T1600, and T4000 routers. The PIC slot numbers are 0 and 1.
  - Packet Forwarding Engine 0 is the physical interface 0, and Packet Forwarding Engine 1 is the physical interface 1.
- 802.3 link aggregation:
  - The configuration of the 40-Gigabit Ethernet PIC with CFP complies with that of the existing 1-Gigabit or 10-Gigabit Ethernet PIC and aggregated Ethernet interfaces.
  - An aggregate bundle that consists purely of 40-Gigabit Ethernet PICs supports a maximum of 40-Gigabit Ethernet links depending on the system implementation.

For Junos OS configuration information about this PIC, see [“Configuring 40-Gigabit Ethernet PICs” on page 393](#). For hardware compatibility information, see the *T1600 PICs Supported* topic in the *T1600 Core Router Hardware Guide* hardware guide and the *T640 PICs Supported* topic in the *T640 Core Router Hardware Guide* hardware guide, and the *T4000 PICs Supported* topic in the *T4000 Core Router Hardware Guide* hardware guide.

**Related  
Documentation**

- [Configuring 40-Gigabit Ethernet PICs on page 393](#)
- *T640 Core Router Hardware Guide*
- *T1600 Core Router Hardware Guide*
- *T4000 Core Router Hardware Guide*
- *TX Matrix Plus Router Hardware Guide*
- *T640 PICs Supported*
- *T1600 PICs Supported*
- *T4000 PICs Supported*

## Configuring 40-Gigabit Ethernet PICs

You can configure the following features on the 40-Gigabit Ethernet PIC with CFP (PD-1XLE-CFP):

- Flexible Ethernet services encapsulation
- Source address MAC filtering
- Destination address MAC filtering
- MAC accounting for receive (Rx) and transmit (Tx)
- Multiple tag protocol ID (TPID) support
- Channels defined by two stacked VLAN tags
- Channels defined by **flex-vlan-tagging**
- IP service for stacked VLAN tags
- IP service for nonstandard TPID

The following features are not supported on the 40-Gigabit Ethernet PIC with CFP:

- MAC learning
- MAC policing
- Layer 2 rewrite



**NOTE:** Each 40-Gigabit Ethernet PIC with CFP creates a single et- physical interface in the Routing Engine and Packet Forwarding Engine.

The 40-Gigabit Ethernet PIC with CFP supports aggregated Ethernet configuration to achieve higher throughput capability, whereby the configuration is similar to the 1-Gigabit or 10-Gigabit aggregated Ethernet interface configuration. A maximum of 40-Gigabit Ethernet PIC links can be bundled into a single aggregated Ethernet configuration depending on the system implementation.

To configure the 40-Gigabit Ethernet PIC with CFP:

1. Perform the media configuration.

The command used to configure the media for the 40-Gigabit Ethernet PIC with CFP is the same as that for other Ethernet PICs, such as the 4-port 10-Gigabit Ethernet PIC.

2. Specify the logical interfaces.

A single physical interface is created when the 40-Gigabit Ethernet PIC with CFP is brought online (et-x/y/0, where x represents the FPC slot number and y represents the PIC slot number). For more information, see [“Configuring Access Mode on a Logical Interface” on page 252](#) and [“Configuring a Logical Interface for Trunk Mode” on page 252](#).

3. Configure the 802.3 link aggregation.

- You must explicitly configure an aggregated interface on the 40-Gigabit Ethernet PIC with CFP that includes the 40-Gigabit Ethernet interfaces. For more information, see [“Configuring an Aggregated Ethernet Interface” on page 126](#).
- The configuration of the 40-Gigabit Ethernet PIC with CFP complies with the configuration of the 1-Gigabit Ethernet PIC, 10-Gigabit Ethernet PIC, and the aggregated Ethernet interfaces. In each aggregated bundle, Junos OS supports a maximum of 40-Gigabit Ethernet links. For more information, see [“Configuring an Aggregated Ethernet Interface” on page 126](#) and [“10-port 10-Gigabit Ethernet LAN/WAN PIC Overview” on page 357](#).

4. Configure the Packet Forwarding Engine features.

The 40-Gigabit Ethernet PIC with CFP supports all classification, firewall filters, queuing model, and rewrite functionality features of the Gigabit Ethernet PICs. To configure these parameters, see [“Configuring Gigabit Ethernet Policers” on page 465](#), [“Configuring MAC Address Filtering” on page 465](#), and [“Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 483](#).

**Related  
Documentation**

- [40-Gigabit Ethernet PIC Overview on page 391](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring MAC Address Filtering on page 465](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)

## CHAPTER 26

# Configuring 100-Gigabit Ethernet PICs/MICs

- [100-Gigabit Ethernet Interfaces Overview on page 395](#)
- [MPC3E MIC Overview on page 397](#)
- [100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 399](#)
- [Configuring 100-Gigabit Ethernet Type 4 PIC With CFP on page 402](#)
- [Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 406](#)
- [100-Gigabit Ethernet Type 5 PIC with CFP Overview on page 408](#)
- [Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-ICGE-CFP on page 410](#)
- [Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 411](#)
- [Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-ICGE-CFP and PD-ICE-CFP-FPC4 on page 413](#)
- [Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 415](#)
- [Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 417](#)

## 100-Gigabit Ethernet Interfaces Overview

---

- [100-Gigabit Ethernet on page 395](#)
- [MX Series 100-Gigabit Ethernet Interfaces on page 396](#)
- [PTX Series 100-Gigabit Ethernet Interfaces on page 396](#)
- [T Series 100-Gigabit Ethernet Interfaces on page 397](#)

## 100-Gigabit Ethernet

Juniper Networks supports a variety of 100-Gigabit Ethernet interfaces. Ethernet was developed in the early 1970s at the Xerox Palo Alto Research Center (PARC) as a data-link control layer protocol for interconnecting computers.

100-Gigabit Ethernet transmits Ethernet frames at a rates of 100 gigabits per second, and was first defined by the IEEE 802.3ba-2010 standard. It is used for very high speed transmission of voice and data signals across the numerous world-wide fiber-optic networks.

## MX Series 100-Gigabit Ethernet Interfaces

[Table 27 on page 396](#) lists the 100-Gigabit Ethernet interfaces supported by MX Series routers.

**Table 27: MX Series 100-Gigabit Ethernet Interfaces**

Interface Module	Model Number	Routers Supported	For More Information
100-Gigabit Ethernet MIC with CFP	MIC3-3D-1X100GE-CFP	MX240	<i>100-Gigabit Ethernet MIC with CFP</i>  <a href="#">“MPC3E MIC Overview” on page 397</a>
		MX480	
		MX960	
		MX2010	
		MX2020	
100-Gigabit Ethernet MIC with CXP	MIC3-3D-1X100GE-CXP	MX240	<i>100-Gigabit Ethernet MIC with CXP</i>  <a href="#">“MPC3E MIC Overview” on page 397</a>
		MX480	
		MX960	
		MX2010	
		MX2020	
100-Gigabit Ethernet ports on the MPC4E	MPC4E-3D-2CGE-8XGE	MX240	<i>MPC4E on MX Series Routers Overview</i>  <i>2x100GE + 8x10GE MPC4E</i>
		MX480	
		MX960	
		MX2010	
		MX2020	

## PTX Series 100-Gigabit Ethernet Interfaces

[Table 28 on page 396](#) lists the 100-Gigabit Ethernet interfaces supported by PTX Series routers.

**Table 28: PTX Series 100-Gigabit Ethernet Interfaces**

PIC	Model Number	Routers Supported	For More Information
100-Gigabit Ethernet PIC with CFP	PI-PTX-2-100GE-CFP	PTX5000	<i>100-Gigabit Ethernet PIC with CFP (PTX Series)</i>



## T Series 100-Gigabit Ethernet Interfaces

Table 29 on page 397 lists the 100-Gigabit Ethernet interfaces supported by T Series routers.

**Table 29: T Series 100-Gigabit Ethernet Interfaces**

PIC	Model Number	Routers Supported	For More Information
100-Gigabit Ethernet PIC with CFP (Type 4)	PD-1CE-CFP-FPC4	T1600	<i>100-Gigabit Ethernet PIC with CFP (T1600 Router)</i>
		T4000	<i>100-Gigabit Ethernet PIC with CFP (T4000 Router)</i>  “100-Gigabit Ethernet Type 4 PIC with CFP Overview” on page 399  “Configuring 100-Gigabit Ethernet Type 4 PIC With CFP” on page 402
100-Gigabit Ethernet PIC with CFP (Type 5)	PF-1CGE-CFP	T4000	<i>100-Gigabit Ethernet PIC with CFP (T4000 Router)</i>  “100-Gigabit Ethernet Type 5 PIC with CFP Overview” on page 408

- Related Documentation**
- *MICs Supported by MX Series Routers*
  - *MPCs Supported by MX240, MX480, MX960, MX2010, and MX2020 Routers*
  - *PICs Supported on the PTX Series*
  - *T1600 PICs Supported*
  - *T4000 PICs Supported*

## MPC3E MIC Overview

The MPC3E supports two separate slots for MICs. MICs provide the physical interface and are installed into the MPCs.

The MPC3E supports these MICs as field replaceable units (FRUs):

- *100-Gigabit Ethernet MIC with CFP* (model number MIC3-3D-1X100GE-CFP)
- *100-Gigabit Ethernet MIC with CXP* (model number MIC3-3D-1X100GE-CXP)
- *10-port 10-Gigabit Ethernet MIC with SFPP* (model number MIC3-3D-10XGE-SFPP)
- *2-port 40-Gigabit Ethernet MIC with QSFP+* (model number MIC3-3D-2X40GE-QSFP)

The MPC3E has two separate configurable MIC slots. Each MIC corresponds to a single PIC and the mapping between the MIC and PIC is 1 to 1 (one MIC is treated as one PIC). The MIC plugged into slot 0 corresponds to PIC 0 and the MIC plugged into slot 1 corresponds to PIC 2.

The MPC3E also supports these legacy MICs:

- 20-port *Gigabit Ethernet MIC with SFP* (model number MIC-3D-20GE-SFP)
- 2-port *10-Gigabit Ethernet MICs with XFP* (model number MIC-3D-2XGE-XFP)

The 100-Gigabit Ethernet CFP MIC supports the IEEE standards—compliant 100BASE-LR4 interface, using the 100G CFP optical transceiver modules for connectivity. The 100-Gigabit Ethernet CXP MIC supports the 100BASE-SR10 interface, using 100-Gigabit CXP optical transceiver modules for connectivity. The 2-port 40-Gigabit Ethernet QSFP MIC supports the 40BASE-SR4 interface and uses quad small form-factor pluggable (QSFP) optical transceivers for connectivity. The 10-port 10-Gigabit Ethernet SFPP MIC uses SFP+ optical transceiver modules for connectivity.

For detailed information about each MIC, see *100-Gigabit Ethernet MIC with CFP*, *100-Gigabit Ethernet MIC with CXP*, *40-Gigabit Ethernet MIC with QSFP+*. For information about supported hardware and transceivers, see *MPC3E*.

The MPC3E supports these features:

- Optical diagnostics and related alarms
- Virtual Router Redundancy Protocol (VRRP) support
- IEEE 802.1Q virtual LANs (VLANs) support
- Synchronous Ethernet
- Remote monitoring (RMON) and Ethernet statistics (EtherStats)
- Source MAC learning
- MAC accounting and policing—Dynamic local address learning of source MAC addresses
- Flexible Ethernet encapsulation
- Multiple Tag Protocol Identifiers (TPIDs)



**NOTE:** The MPC3E supports Ethernet interfaces only. SONET interfaces are not supported.

---

For information about the supported and unsupported Junos OS features for this MPC, see “Protocols and Applications Supported by the MPC3E (MX-MPC3E)” in the [MX Series Interface Module Reference](#).

**Related  
Documentation**

- *MPC3E on MX Series Routers Overview*
- *Protocols and Applications Supported by the MX240, MX480, MX960, MX2010, and MX2020 MPC3E*

- *100-Gigabit Ethernet MIC with CFP*
- *100-Gigabit Ethernet MIC with CXP*
- *2-port 40-Gigabit Ethernet MIC with QSFP+*
- *2-port 10-Gigabit Ethernet MICs with XFP*
- *MX Series Interface Module Reference*

---

## 100-Gigabit Ethernet Type 4 PIC with CFP Overview

The 100-Gigabit Ethernet PIC (model number PD-1CE-CFP-FPC4) is a 1-port 100-Gigabit Ethernet Type 4 PIC with 100-gigabit small form-factor pluggable (CFP) transceiver. This PIC is available only as packaged in an assembly with the T1600-FPC4-ES FPC. The 100-Gigabit Ethernet PIC occupies PIC slots 0 and 1 in the T1600-FPC4-ES FPC. For information about supported transceivers and hardware, see *100-Gigabit Ethernet PIC with CFP (T1600 Router)*.

The 100-Gigabit Ethernet PIC supports flexible encapsulation and MAC accounting.

MAC learning, MAC policing, and Layer 2 rewrite functionality are not supported.

The ingress flow can be filtered based on the VLAN source and destination addresses. Ingress frames can also be classified according to VLAN, stacked VLAN, source address, VLAN source address, and stacked VLAN source address. VLAN manipulation on egress frames are supported on both outer and inner VLAN tags.

The following features are supported:

- The following encapsulation protocols are supported:
  - Layer 2 protocols
    - Ethernet CCC, Ethernet TCC, Ethernet VPLS
    - VLAN CCC
    - Extended VLAN TCC
    - VLAN VPLS
    - Flexible Ethernet service
  - Layer 3 protocols
    - IPv4
    - IPv6
    - MPLS
- CFP MSA compliant MDIO control features (transceiver dependent).
- Graceful Routing Engine switchover (GRES) is supported in all PIC and chassis configurations.

- Interface creation:
  - When the PIC is brought online, the router creates two 50 gigabit capable interfaces, **et-x/0/0:0** and **et-x/0/0:1**, where *x* represents the FPC slot number. Each physical interface represents two internal 50 gigabit Ethernet Packet Forwarding Engines. Two logical interfaces are configured under each physical interface.
  - Packet Forwarding Engine 0 is physical interface 0, Packet Forwarding Engine 1 is physical interface 1

- 802.3 link aggregation:

Same rate or same mode link aggregation:

- Two logical interfaces are created for each 100-Gigabit Ethernet PIC. To utilize bandwidth beyond 50 gigabits per second, an aggregate interface must be explicitly configured on the 100-Gigabit Ethernet PIC that includes the two 50 gigabit interfaces.
- Each 100 gigabit Ethernet aggregate consumes one of the router-wide aggregated Ethernet device pools. The number of 100-Gigabit Ethernet PICs cannot exceed the router-wide limit, which is 128 for Ethernet.
- In each aggregate bundle, each 100-Gigabit Ethernet PIC consumes two members. Hence, an aggregate bundle that consists purely of 100-Gigabit Ethernet PICs supports a maximum of half of the software limit for the number of members. Therefore, with a maximum of 16 links, up to 8 100-Gigabit Ethernet links are supported.
- Combining 100-Gigabit Ethernet PICs into aggregate interfaces with other Ethernet PICs is not permitted. However, other Ethernet PICs can also be configured within the same T1600 with 100-Gigabit Ethernet PICs, and used in separate aggregate interfaces.
- Multiple (Juniper Networks) Type 4 100-Gigabit Ethernet PICs on a T1600 router can be combined into a static aggregated Ethernet bundle to connect to a different type of 100 gigabit Ethernet PIC on a remote router (Juniper Networks or other vendors). LACP is not supported in this configuration.

Mixed rate or mixed mode link aggregation:

- Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on 100-Gigabit Ethernet PIC.
- Static link protection and Link Aggregation Control Protocol (LACP) is supported on mixed aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC.
- When configuring a mixed aggregated Ethernet link on a 100-Gigabit Ethernet PIC, ensure that you add both the 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC to the aggregated Ethernet bundle. Moreover, both these 50-Gigabit Ethernet interfaces must be included in the same aggregated Ethernet bundle.
- For a single physical link event of an aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC, the packet loss performance value is twice the original value because of the *two* 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC.

- Software Packet Forwarding Engine—Supports all Gigabit Ethernet PIC classification, firewall filter, queuing model, and rewrite functionality.
- Egress traffic performance—Maximum egress throughput is 100 gigabits per second on the physical interface, with 50 gigabits per second on the two assigned logical interfaces.
- Ingress traffic performance—Maximum ingress throughput is 100 gigabits per second on the physical interface, with 50 gigabits per second on the two assigned logical interfaces. To achieve 100 gigabits per second ingress traffic performance, use one of the interoperability modes described below. For example, if VLAN steering mode is not used when connecting to a remote 100 gigabits per second interface (that is on a different 100 gigabits per second PIC on a Juniper Networks router or a different vendor's equipment), then all ingress traffic will try to use one of the 50 gigabits per second Packet Forwarding Engines, rather than be distributed among the two 50 gigabits per second Packet Forwarding Engines, resulting in a total of 50 gigabits per second ingress performance.
- Interoperability modes—The 100-Gigabit Ethernet PIC supports interoperability with through configuration in one of the following two forwarding option modes:
  - *SA multicast mode*—In this mode, the 100-Gigabit Ethernet PIC supports interconnection with other Juniper Networks 100-Gigabit Ethernet PICs (Model: PD-1CE-CFP) interfaces only.
  - *VLAN steering mode*—In this mode, the 100-Gigabit Ethernet Type 4 PIC with CFP supports interoperability with 100 gigabit Ethernet interfaces from other vendors only.

**Related  
Documentation**

- [Configuring 100-Gigabit Ethernet Type 4 PIC With CFP on page 402](#)
- *T1600 Core Router Hardware Guide*
- *100-Gigabit Ethernet PIC with CFP (T1600 Router)*
- *100-Gigabit Ethernet PIC with CFP (T4000 Router)*

## Configuring 100-Gigabit Ethernet Type 4 PIC With CFP

---

You can configure the following features on the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4):

- Flexible Ethernet services encapsulation
- Source address MAC filtering
- Destination address MAC filtering
- MAC accounting in RX
- Channels defined by two stacked VLAN tags
- Channels defined by flex-vlan-tagging
- IP service for stacked VLAN tags
- Layer 2 rewrite

The following features are not supported on the 100-Gigabit Ethernet Type 4 PIC with CFP:

- Multiple TPID
- IP service for non-standard TPID
- MAC learning
- MAC policing



### NOTE:

- For the 100-Gigabit Ethernet Type 4 PIC with CFP, only the PICO online and offline CLI commands are supported. The PIC1 online and offline CLI commands are not supported.
  - Each 100-Gigabit Ethernet Type 4 PIC with CFP creates two et- physical interfaces, defined as 50-gigabit physical interfaces in the Routing Engine and Packet Forwarding Engine. By default, these are independent physical interfaces and are not configured as an aggregated Ethernet interface.
-

To configure a 100-Gigabit Ethernet Type 4 PIC with CFP:

1. Perform the media configuration:

The 100-Gigabit Ethernet Type 4 PIC with CFP features a 100 gigabit per second pipe. The media-related configuration commands for **et-x/0/0:0** and **et-x/0/0:1** must both be configured at the same time and configured with the same value, otherwise the commit operation fails.

When configuring to activate or deactivate the interface, if the interface contains the described media-related configuration, it must activate and deactivate both units 0 and 1 at the same time, otherwise the commit operation fails.

The following media configuration commands have the above described restriction:

- **# set interfaces et-x/0/0:1 disable**
- **# set interfaces et-x/0/0:1 gigether-options loopback**
- **# set interfaces et-x/0/0:1 mtu yyy**

Due to an MTU restriction, the vlan-tagging and flexible-vlan-tagging configuration on et-x/0/0:0 and et-x/0/0:1 must be same, otherwise the commit operation fails.

2. Specify the logical interfaces:

- a. Two physical interfaces are created when the 100-Gigabit Ethernet Type 4 PIC with CFP is brought online (**et-x/0/0:0** and **et-x/0/0:1**, where *x* represents the FPC slot number). Each physical interface represents two internal 50-gigabit Ethernet Packet Forwarding Engines.
- b. Two logical interfaces are configured under each physical interface: Packet Forwarding Engine 0 is physical interface 0 and Packet Forwarding Engine 1 is physical interface 1.

3. Configure the 802.3 link aggregation:

- a. The 100-Gigabit Ethernet PIC supports aggregated Ethernet configuration to achieve higher throughput capability, whereby configuration is similar to the 1G/10G aggregated Ethernet interface configuration.
- b. Two physical interfaces are created for each 100-Gigabit Ethernet Type 4 PIC with CFP. To utilize bandwidth beyond 50 gigabits, a same rate and same mode aggregated Ethernet interface must be explicitly configured on the 100-Gigabit Ethernet Type 4 PIC with CFP that includes these two 50-gigabit interfaces.
- c. Each 100-Gigabit Ethernet Type 4 PIC with CFP aggregate consumes one of the router-wide aggregated Ethernet device pools. In Junos OS with 100-Gigabit Ethernet PICs, you cannot exceed the router limit of 128 Ethernet PICs.
- d. In each aggregated bundle, each 100-Gigabit Ethernet Type 4 PIC with CFP consumes two aggregate members. Hence, an aggregated bundle consisting of only one 100-Gigabit Ethernet Type 4 PIC with CFP supports only up to half of the Junos OS limit for the number of members. The Junos OS supports a maximum of 16 links for up to 8 100-Gigabit Ethernet Type 4 PIC with CFP links.



---

**NOTE:**

The 100-Gigabit Ethernet Type 4 PIC with CFP has the following restrictions for same rate and same mode aggregated Ethernet configuration:

- Both physical interfaces belonging to the same 100-Gigabit Ethernet PIC must be included in the same aggregated Ethernet physical interfaces. The aggregation of the 100-Gigabit Ethernet PIC interface is always an even number of physical interfaces.
  - The 100-Gigabit Ethernet PIC physical interface cannot be configured in the aggregated interface with any other type of physical interface.
  - The maximum supported number of aggregated 100-Gigabit Ethernet PIC interfaces is half of the number that the Junos OS supports for 1G/10G aggregated Ethernet. For example, if Junos OS supports 16 ports of 10-gigabit Ethernet aggregation, it supports 8 ports of 100-Gigabit Ethernet PIC aggregation. This is because each port of the 100-Gigabit Ethernet PIC port using 2 physical interfaces (et-x/0/0:0 and et-x/0/0:1), where each physical interface represents 50 gigabits of traffic capacity.
- 

- e. Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on 100-Gigabit Ethernet PIC. When configuring a mixed aggregated Ethernet link on a 100-Gigabit Ethernet PIC, ensure that you add both the 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC to the aggregated Ethernet bundle. Moreover, both these 50-Gigabit Ethernet interfaces must be included in the same aggregated Ethernet bundle.



**NOTE:**

The 100-Gigabit Ethernet Type 4 PIC with CFP has the following restrictions for mixed rate and mixed mode aggregated Ethernet configuration:

- A maximum of 16 member links can be configured to form a mixed aggregated Ethernet link.
- Traffic distribution is based on the hash calculated on the egress packet header. Hash range is fairly distributed according to member links' speed. This guarantees hash fairness but it does not guarantee fair traffic distribution depending on the rate of the egress streams.
- Packets are dropped when the total throughput of the hash flow exiting a member link (or multiple hash flows exiting a single member link) exceeds the link speed of the member link. This can happen when egress member link changes because of a link failure and the hash flow switches to a member link of speed that is less than the total throughput of the hash flow.
- Rate-based CoS components such as scheduler, shaper, and policer are not supported on mixed rate aggregated Ethernet links. However, the default CoS settings are supported by default on the mixed rate aggregated Ethernet links.
- Load balancing is performed at the ingress Packet Forwarding Engine. Therefore, you must ensure that the egress traffic on the aggregated Ethernet link enters through the hardware platforms that support mixed aggregated Ethernet bundles.
- Mixed aggregated Ethernet links can interoperate with non-Juniper Networks aggregated Ethernet member links provided that mixed aggregated Ethernet load balancing is configured at egress.
- Load balancing of the egress traffic across the member links of a mixed rate aggregated Ethernet link is proportional to the rates of the member links.
- Egress multicast load balancing is not supported on mixed aggregated Ethernet interfaces.
- Changing the edit interfaces `aex aggregated-ether-options link-speed` configuration of a mixed aggregated Ethernet link, which is configured on the supported interfaces of on T640, T1600, T4000, and TX Matrix Plus routers, leads to aggregated Ethernet link flapping.
- When a mixed aggregated Ethernet link is configured on a 100-Gigabit Ethernet PIC, changing aggregated Ethernet link protection configurations leads to aggregated Ethernet link flapping.
- For a single physical link event of an aggregated Ethernet link configured on a 100-Gigabit Ethernet PIC, the packet loss performance value is twice the original value because of the *two* 50-Gigabit Ethernet interfaces of the 100-Gigabit Ethernet PIC with CFP.

- The **show interfaces aex** command displays the link speed of the aggregated Ethernet interface, which is the sum of the link speeds of all the active member links.

---

4. Configure the Packet Forwarding Engine features:

- a. The 100-Gigabit Ethernet Type 4 PIC with CFP supports all classification, firewall filters, queuing model, and rewrite functionality features of the Gigabit Ethernet PICs. To configure these parameters, see [“Configuring Gigabit Ethernet Policers” on page 465](#), [“Configuring MAC Address Filtering” on page 465](#), and [“Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 483](#).



**NOTE:** When using the **show interfaces extensive** command with a 100-Gigabit Ethernet Type 4 PIC with CFP, the “Filter statistics” section will not be displayed because the hardware does not include those counters.

---

**Related Documentation**

- [100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 399](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring MAC Address Filtering on page 465](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)

---

## Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP

---

In Junos OS Release 10.4 and later, you can configure the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4) to interoperate with routers using 100 gigabit Ethernet interfaces from other vendors by using the **forwarding-mode** statement with the **vlan-steering** option at the **[edit chassis fpc slot pic slot]** hierarchy level. On ingress, the router compares the outer VLAN ID against the user-defined VLAN ID and VLAN mask combination and steers the packet accordingly. You can program a custom VLAN ID and corresponding mask for PFE0.

General information on the VLAN steering mode:

- In VLAN steering mode, the SA multicast parameters are not used for packet steering.
- In SA multicast bit steering mode, the VLAN ID and VLAN masks are not used for packet steering.
- Configuration to set the packet distribution mode and VLAN steering rule is done through CLI commands. Both CLI commands result in a PIC reboot.
- There are three possible tag types of ingress packet:
  - Untagged ingress packet—The packet is sent to PFE1.
  - Ingress packet with one VLAN—The packet is forwarded to the corresponding PFE based on the VLAN ID.

- Ingress packet with two VLANs—The packet is forwarded to the corresponding PFE based on the outer VLAN ID.
- If no VLAN rule is configured, all tagged packets are distributed to PFE0.
- VLAN rules describe how the router distributes packets. Two VLAN rules are provided by the CLI:
  - Odd-Even rule—Odd number VLAN IDs go to PFE1; even number of VLAN IDs go to PFE0.
  - Hi-Low rule—VLAN IDs 1 through 2047 go to PFE0; VLAN IDs 2048 through 4096 go to PFE1.
- When the 100-Gigabit Ethernet Type 4 PIC with CFP is configured in VLAN steering mode, it can be configured in a two physical interfaces mode or in aggregate Ethernet (AE) mode:
  - Two physical interfaces mode—When the PIC is in the two physical interfaces mode, it creates the physical interfaces **et-x/0/0:0** and **et-x/0/0:1**. Each physical interface can configure its own logical interface and VLAN. The CLI enforces the following restrictions at the commit time:
    - The VLAN ID configuration must comply with the selected VLAN rule.
    - The previous restriction implies that the same VLAN ID cannot be configured on both physical interfaces.
  - AE mode—When the PIC is in aggregated Ethernet mode, the two physical interfaces on the same PIC are aggregated into one AE physical interface. The PIC egress traffic is based on an AE internal hash algorithm. The PIC ingress traffic steering is based on the customized VLAN ID rule. The CLI enforces the following restrictions at the commit time:
    - The PICs AE working in VLAN steering mode includes both links of that PIC, and only the links of that PIC.
    - The PIC AE working in SA multicast steering mode can include more than one 100-Gigabit Ethernet Type 4 PIC with CFP to achieve more than 100 gigabit Ethernet capacity.

To configure SA multicast mode, use the **set chassis fpc slot pic slot forwarding-mode sa-multicast** command.

#### SA Multicast Mode

To configure SA multicast mode on a Juniper Networks 100-Gigabit Ethernet Type 4 PIC with CFP in FPC 0, PIC 0 for interconnection with another Juniper Networks 100-Gigabit Ethernet PIC, use the **set chassis fpc slot pic slot forwarding-mode sa-multicast** command. You can use the **show forwarding-mode** command to view the resulting configuration, as follows:

```
[edit chassis fpc slot pic slot]
user@host# show forwarding-mode
forwarding-mode {
  sa-multicast;
}
```

**VLAN Steering Mode** To configure the Juniper Networks 100-Gigabit Ethernet Type 4 PIC with CFP for VLAN steering mode for interoperation with a 100 gigabit Ethernet interface from another vendor's router, use the **set chassis fpc slot pic slot forwarding-mode vlan-steering** command with the **vlan-rule (high-low | odd-even)** statement. You can use the **show forwarding-mode** command to view the resulting configuration, as follows:

```
[edit chassis fpc slot pic slot]
user@host# show forwarding-mode
forwarding-mode {
  vlan-steering {
    vlan-rule odd-even;
  }
}
```

**Related  
Documentation**

- [forwarding-mode \(100-Gigabit Ethernet\) on page 974](#)
- [sa-multicast \(100-Gigabit Ethernet\) on page 1162](#)
- [vlan-rule \(100-Gigabit Ethernet Type 4 PIC with CFP\) on page 1244](#)
- [vlan-steering \(100-Gigabit Ethernet Type 4 PIC with CFP\) on page 1245](#)

---

## 100-Gigabit Ethernet Type 5 PIC with CFP Overview

The 100-Gigabit Ethernet PIC is a 1-port 100-Gigabit Ethernet Type 5 PIC with C form-factor pluggable transceiver (CFP) with model number PF-ICGE-CFP.

The following features are supported on 100-Gigabit Ethernet Type 5 PIC with CFP:

- Access to all 100-Gigabit Ethernet port counters through SNMP.
- Logical interface—level MAC filtering, accounting, policing, and learning for source media access control (MAC).
- Channels defined by two stacked VLAN tags.
- Channels defined by **flex-vlan-tagging**.
- IP service for stacked VLAN tags.
- Defining the rewrite operation to be applied to the incoming and outgoing frames on logical interfaces on this PIC.



**NOTE:** Only the Tag Protocol Identifier (TPID) 0x8100 is supported.

---

- Interface encapsulations, such as the following:
  - **untagged**—Default encapsulation, when other encapsulation is not configured.
    - You can configure only one logical interface (unit 0) on the port.
    - You cannot include the **vlan-id** statement in the configuration of the logical interface.
  - **vlan-tagging**—Enable VLAN tagging for all logical interfaces on the physical interface.

- **stacked-vlan-tagging**—Enable stacked VLAN tagging for all logical interfaces on the physical interface.
- **ethernet-ccc**—Ethernet cross-connect.
- **ethernet-tcc**—Ethernet translational cross-connect.
- **vlan-ccc**—802.1Q tagging for a cross-connect.
- **vlan-tcc**—Virtual LAN (VLAN) translational cross-connect.
- **extended-vlan-ccc**—Standard TPID tagging for an Ethernet cross-connect.
- **extended-vlan-tcc**—Standard TPID tagging for an Ethernet translational cross-connect.
- **flexible-ethernet-services**—Allows per-unit Ethernet encapsulation configuration.
- **ethernet-vpls**—Ethernet virtual private LAN service.
- **vlan-vpls**—VLAN virtual private LAN service.
- The following Layer 3 protocols are also supported:
  - IPv4
  - IPv6
  - MPLS
- CFP Multi-Source Agreement (MSA) compliant Management Data Input/Output (MDIO) control features (transceiver dependent).
- 802.3 link aggregation:
  - The configuration of the 100-Gigabit Ethernet Type 5 PIC with CFP complies with that of the existing 1-Gigabit or 10-Gigabit Ethernet PIC and aggregated Ethernet interfaces.
- Interoperability mode—Interoperability with the 100-Gigabit Ethernet Type 4 PIC with CFP through configuration in **sa-multicast** forwarding mode.
- Juniper Networks enterprise-specific Ethernet Media Access Control (MAC) MIB
- The 100-Gigabit Ethernet Type 5 PIC with CFP supports all Gigabit Ethernet PIC classification, firewall filters, queuing model, and Layer 2 rewrite functionality features of the Gigabit Ethernet PICs. To configure these parameters, see [“Configuring Gigabit Ethernet Policers” on page 465](#), [“Configuring MAC Address Filtering” on page 465](#), and [“Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 483](#).
- A Type 5 FPC can support up to two 100-Gigabit Ethernet PICs. Both the PICs (that is, PIC 0 and PIC 1) can be offline or online independently.

The following features are not supported on the 100-Gigabit Ethernet Type 5 PIC with CFP:

- MAC filtering, accounting, and policing for destination MAC at the logical interface level.



**NOTE:** Because destination MAC filtering is not supported, the hardware is configured to accept all the multicast packets. This configuration enables the OSPF protocol to work.

- Premium MAC policers at the logical interface level.
- MAC filtering, accounting, and policing at the physical interface level.
- Multiple TPIDs.
- IP service for nonstandard TPID.

Table 30 on page 410 lists the capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP.

**Table 30: Capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP**

Capability	Support
Maximum logical interfaces per PIC	4093
Maximum logical interfaces per port	For IPv4 the limit is 4093. For IPv6 the limit is 1022.

#### Related Documentation

- [Configuring 100-Gigabit Ethernet Type 4 PIC With CFP on page 402](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring MAC Address Filtering on page 465](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)

## Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-ICGE-CFP

You can enable interoperability between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-ICGE-CFP by:

- Enabling source address (SA) multicast bit steering mode on the 100-Gigabit Ethernet PIC PF-ICGE-CFP.
- Configuring the two 50-Gigabit Ethernet physical interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 as one aggregated Ethernet physical interface.

SA multicast mode uses the multicast bit in the source MAC address for packet steering. By default, the SA multicast bit is set to 0 for all packets sent by the 100-Gigabit Ethernet

PIC PF-1CGE-CFP. The 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 looks at the bit and forwards the packets to either Packet Forwarding Engine 0 or Packet Forwarding Engine 1. When the PIC sends out a packet, the multicast bit is set based on the egress Packet Forwarding Engine number (0 or 1).

The default packet steering mode for PD-1CE-CFP-FPC4 is SA multicast bit mode. No SA multicast configuration is required to enable this mode.

PD-1CE-CFP-FPC4 uses two 50 Gbps Packet Forwarding Engines to achieve 100 Gbps throughput. The 50-Gigabit Ethernet physical interfaces are created when the 100-Gigabit Ethernet PIC is plugged in. The two physical interfaces are visible and configuration is allowed on both the physical interfaces. You must configure the physical interfaces on PD-1CE-CFP-FPC4 in static link aggregation group (LAG) mode without enabling Link Aggregation Control Protocol (LACP). This ensures that a single 100-Gigabit aggregated interface is visible on the link connecting to the 100-Gigabit Ethernet PIC PF-1CGE-CFP instead of two independent 50-Gigabit Ethernet interfaces.



**NOTE:** If you try to enable the interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP without configuring PD-1CE-CFP-FPC4 (with two 50-Gigabit Ethernet interfaces) in static LAG mode, then there are issues in forwarding or routing protocols. For example, if you create two untagged logical interfaces—one each on the two 50-Gigabit Ethernet interfaces—on PD-1CE-CFP-FPC4 and one untagged logical interface on PF-1CGE-CFP, then PF-1CGE-CFP does not learn about one of the 50-Gigabit Ethernet interfaces on PD-1CE-CFP-FPC4.

#### Related Documentation

- [forwarding-mode on page 974](#)
- [sa-multicast on page 1162](#)
- [Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4 on page 413](#)
- *100-Gigabit Ethernet PIC with CFP (T1600 Router)*
- *100-Gigabit Ethernet PIC with CFP (T4000 Router)*

## Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP

You can enable interoperability between the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 and the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP by:

- Configuring the two 50-Gigabit Ethernet physical interfaces on the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 as one aggregated Ethernet physical interface.
- Configuring source address (SA) multicast bit steering mode on the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP.

SA multicast bit steering mode uses the multicast bit in the source MAC address for packet steering.



**NOTE:** When SA multicast bit steering mode is configured on a PTX Series Packet Transport Router 100-Gigabit Ethernet port, VLANs are not supported for that port.

The 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 uses two 50-Gbps Packet Forwarding Engines to achieve 100-Gbps throughput. The 50-Gigabit Ethernet physical interfaces are created when the 100-Gigabit Ethernet PIC is plugged in. The two physical interfaces are visible and configuration is allowed on both the physical interfaces. You must configure the physical interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 in static link aggregation group (LAG) mode without enabling Link Aggregation Control Protocol (LACP). This ensures that a single 100-Gigabit aggregated interface is visible on the link connecting to the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP.

On the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4, ingress packets are forwarded to either Packet Forwarding Engine number 0 or 1 based on the SA multicast bit in the received packet. The SA multicast bit of egress packets is set based on whether the packet is forwarded from Packet Forwarding Engine number 0 or 1. As the default packet steering mode is SA multicast bit steering mode, no configuration is necessary to enable this mode.

On the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP, the SA multicast bit is ignored in ingress packets. When SA multicast bit steering mode is enabled, the SA multicast bit in the egress packets is set to 0 or 1 based on the flow hash value that is computed internally by the Packet Forwarding Engine complex for each packet. No CLI configuration is required to generate the flow hash value as this computation is done automatically. The flow hash algorithm uses fields in the packet header to compute the flow hash value. By default, the SA multicast bit is set to 0 in egress packets. You must configure SA multicast bit steering mode to enable interoperability with the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4.



**NOTE:** If you try to enable the interoperability between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP without configuring PD-ICE-CFP-FPC4 (with two 50-Gigabit Ethernet interfaces) in static LAG mode, then there are issues in forwarding or routing protocols. For example, if you create two untagged logical interfaces—one each on the two 50-Gigabit Ethernet interfaces—on the PD-ICE-CFP-FPC4 and one untagged logical interface on the P1-PTX-2-100GE-CFP, then P1-PTX-2-100GE-CFP does not learn about one of the 50-Gigabit Ethernet interfaces on PD-ICE-CFP-FPC4.

**Related  
Documentation**

- [Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 415](#)
- [sa-multicast on page 1163](#)



- [Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 410](#)

## Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4

You can enable interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP by performing the following tasks:

- [Configuring SA Multicast Bit Steering Mode on the 100-Gigabit Ethernet PIC PF-1CGE-CFP on page 413](#)
- [Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 as One Aggregated Ethernet Interface on page 414](#)

### Configuring SA Multicast Bit Steering Mode on the 100-Gigabit Ethernet PIC PF-1CGE-CFP

To enable the interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP, you need to enable source address (SA) multicast bit steering mode on PF-1CGE-CFP.

To configure SA multicast mode on PF-1CGE-CFP:

1. Specify the FPC and PIC information on the chassis.

```
[edit ]
user@host# edit chassis fpc slot pic slot
```

For example:

```
[edit ]
user@host# edit chassis fpc 1 pic 0
```

2. Configure the interoperation mode (SA multicast bit steering mode).

```
[edit chassis fpc slot pic slot]
user@host# set forwarding-mode sa-multicast
```

For example:

```
[edit fpc 1 pic 0]
user@host# set forwarding-mode sa-multicast
```

3. Verify the configuration.

```
[edit ]
user@host# show chassis
fpc 1 {
  pic 0 {
    forwarding-mode {
      sa-multicast;
    }
  }
}
```



**NOTE:** The default packet steering mode for the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 is SA multicast bit mode. No SA multicast configuration is required to enable this mode.

## Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 as One Aggregated Ethernet Interface

To enable the interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP or P1-PTX-2-100GE-CFP, you need to configure the two 50-Gigabit Ethernet physical interfaces on PD-1CE-CFP-FPC4 as one aggregated Ethernet physical interface. This ensures that a single 100-Gigabit aggregated interface is visible on the link connecting to PF-1CGE-CFP or P1-PTX-2-100GE-CFP instead of two independent 50-Gigabit Ethernet interfaces.

When the PIC is in aggregated Ethernet mode, the two physical interfaces on the same PIC are aggregated into one aggregated Ethernet physical interface. When the PIC is configured with two physical interfaces, it creates the physical interfaces `et-fpc/pic/0:0` and `et-fpc/pic/0:1`, where *fpc* is the FPC slot number and *pic* is the PIC slot number. For example, to configure two physical interfaces for PIC slot 0 in FPC slot 5:

1. Specify the number of aggregated Ethernet interfaces to be created.

```
[edit chassis]
user@host# set aggregated devices ethernet device-count count
```

For example:

```
[edit chassis]
user@host# set aggregated devices ethernet device-count 1
```

2. Specify the members to be included within the aggregated Ethernet bundle.

```
[edit interfaces ]
user@host# set interface-name gigether-options 802.3ad bundle
```

The following example shows how to configure two physical interfaces for PIC 0 on a T1600 router.

```
[edit interfaces ]
user@host# set et-5/0/0:0 gigether-options 802.3ad ae0
user@host# set et-5/0/0:1 gigether-options 802.3ad ae0
```

3. Verify the configuration at the chassis.

```
[edit ]
user@host# show chassis
  aggregated-devices {
    ethernet {
      device-count 1;
    }
  }
```

4. Verify the configuration at the interface.

```
[edit ]
```

```

user@host# show interfaces
et-5/0/0:0 {
  gigether-options {
    802.3ad ae0;
  }
}
et-5/0/0:1 {
  gigether-options {
    802.3ad ae0;
  }
}

```

- Related Documentation**
- [Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-1CGE-CFP on page 410](#)
  - *100-Gigabit Ethernet PIC with CFP (T1600 Router)*
  - *100-Gigabit Ethernet PIC with CFP (T4000 Router)*

## Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4

You can enable interoperability between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP by performing the following tasks:

- [Configuring SA Multicast Bit Steering Mode on 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP on page 415](#)
- [Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 as One Aggregated Ethernet Interface on page 416](#)

### Configuring SA Multicast Bit Steering Mode on 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP

To enable the interoperability between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP, you must enable source address (SA) multicast bit steering mode on P1-PTX-2-100GE-CFP.



**NOTE:** When you configure the SA multicast bit steering mode on the PTX Series PIC P1-PTX-2-100GE-CFP, we recommend that you do not configure the PIC ports as member links of an aggregated Ethernet interface because this prevents load balancing on the peering T Series PIC PD-ICE-CFP-FPC4. This T Series PIC must be in aggregated Ethernet mode to share bandwidth between its two 50-Gigabit Ethernet interfaces.

To configure SA multicast bit steering mode on the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP:

1. Specify the FPC, PIC, and port information on the chassis.

[edit]

```
user@host# edit chassis fpc slot pic slot port port-number
```

For example:

```
[edit ]
user@host# edit chassis fpc 1 pic 0 port 0
```

2. Configure the interoperation mode (SA multicast bit steering mode).

```
[edit chassis fpc 1 pic 0]
user@host# set forwarding-mode sa-multicast
```

3. Verify the configuration.

```
[edit ]
user@host# show chassis
fpc 1 {
  pic 0 {
    port 0 {
      forwarding-mode {
        sa-multicast;
      }
    }
  }
}
```



**NOTE:** As the default packet steering mode for the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 is SA multicast bit steering mode, no configuration is necessary to enable this mode.

## Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 as One Aggregated Ethernet Interface

To enable the interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP or P1-PTX-2-100GE-CFP, you need to configure the two 50-Gigabit Ethernet physical interfaces on PD-1CE-CFP-FPC4 as one aggregated Ethernet physical interface. This ensures that a single 100-Gigabit aggregated interface is visible on the link connecting to PF-1CGE-CFP or P1-PTX-2-100GE-CFP instead of two independent 50-Gigabit Ethernet interfaces.

When the PIC is in aggregated Ethernet mode, the two physical interfaces on the same PIC are aggregated into one aggregated Ethernet physical interface. When the PIC is configured with two physical interfaces, it creates the physical interfaces `et-fpc/pic/0:0` and `et-fpc/pic/0:1`, where *fpc* is the FPC slot number and *pic* is the PIC slot number. For example, to configure two physical interfaces for PIC slot 0 in FPC slot 5:

1. Specify the number of aggregated Ethernet interfaces to be created.

```
[edit chassis]
user@host# set aggregated devices ethernet device-count count
```

For example:

```
[edit chassis]
user@host# set aggregated devices ethernet device-count 1
```

- Specify the members to be included within the aggregated Ethernet bundle.

```
[edit interfaces ]
user@host# set interface-name gigether-options 802.3ad bundle
```

The following example shows how to configure two physical interfaces for PIC 0 on a T1600 router.

```
[edit interfaces ]
user@host# set et-5/0/0:0 gigether-options 802.3ad ae0
user@host# set et-5/0/0:1 gigether-options 802.3ad ae0
```

- Verify the configuration at the chassis.

```
[edit ]
user@host# show chassis
  aggregated-devices {
    ethernet {
      device-count 1;
    }
  }
```

- Verify the configuration at the interface.

```
[edit ]
user@host# show interfaces
  et-5/0/0:0 {
    gigether-options {
      802.3ad ae0;
    }
  }
  et-5/0/0:1 {
    gigether-options {
      802.3ad ae0;
    }
  }
```

#### Related Documentation

- [Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 411](#)
- [sa-multicast on page 1163](#)
- [Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 410](#)

## Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength

To configure the wavelength on 10-Gigabit Ethernet or 100-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) and OTN interfaces, include the **wavelength** statement at the **[edit interfaces *interface-name* optics-options]** hierarchy level:

```
[edit interfaces interface-name optics-options]
  wavelength nm;
```

To display the currently tuned wavelength and frequency for the interface, use the **show interfaces *interface-name*** operational mode command.

For interface diagnostics, issue the **show interfaces diagnostics optics *interface-name*** operational mode command.

[Table 26 on page 382](#) shows configurable wavelengths and the corresponding frequency for each configurable wavelength.

**Table 31: Wavelength-to-Frequency Conversion Matrix**

Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)
1528.38	196.15	1542.14	194.40	1556.15	192.65
1528.77	196.10	1542.54	194.35	1556.55	192.60
1529.16	196.05	1542.94	194.30	1556.96	192.55
1529.55	196.00	1543.33	194.25	1557.36	192.50
1529.94	195.95	1543.73	194.20	1557.77	192.45
1530.33	195.90	1544.13	194.15	1558.17	192.40
1530.72	195.85	1544.53	194.10	1558.58	192.35
1531.12	195.80	1544.92	194.05	1558.98	192.30
1531.51	195.75	1545.32	194.00	1559.39	192.25
1531.90	195.70	1545.72	193.95	1559.79	192.20
1532.29	195.65	1546.12	193.90	1560.20	192.15
1532.68	195.60	1546.52	193.85	1560.61	192.10
1533.07	195.55	1546.92	193.80	1561.01	192.05
1533.47	195.50	1547.32	193.75	1561.42	192.00
1533.86	195.45	1547.72	193.70	1561.83	191.95
1534.25	195.40	1548.11	193.65	1562.23	191.90
1534.64	195.35	1548.51	193.60	1562.64	191.85
1535.04	195.30	1548.91	193.55	1563.05	191.80
1535.43	195.25	1549.32	193.50	1563.45	191.75

Table 31: Wavelength-to-Frequency Conversion Matrix (*continued*)

Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)
1535.82	195.20	1549.72	193.45	1563.86	191.70
1536.22	195.15	1550.12	193.40	1564.27	191.65
1536.61	195.10	1550.52	193.35	1564.68	191.60
1537.00	195.05	1550.92	193.30	1565.09	191.55
1537.40	195.00	1551.32	193.25	1565.50	191.50
1537.79	194.95	1551.72	193.20	1565.90	191.45
1538.19	194.90	1552.12	193.15	1566.31	191.40
1538.58	194.85	1552.52	193.10	1566.72	191.35
1538.98	194.80	1552.93	193.05	1567.13	191.30
1539.37	194.75	1553.33	193.00	1567.54	191.25
1539.77	194.70	1553.73	192.95	1567.95	191.20
1540.16	194.65	1554.13	192.90	1568.36	191.15
1540.56	194.60	1554.54	192.85	1568.77	191.10
1540.95	194.55	1554.94	192.80		
1541.35	194.50	1555.34	192.75		
1541.75	194.45	1555.75	192.70		

- Related Documentation**
- [Ethernet DWDM Interface Wavelength Overview on page 381](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)
  - [wavelength on page 1253](#)





## CHAPTER 27

# Configuring Gigabit Ethernet OTN Options

- [Gigabit Ethernet OTN Options on page 421](#)
- [10-Gigabit Ethernet OTN Options Configuration Overview on page 422](#)
- [Understanding the P1-PTX-24-10G-W-SFPP PIC on page 423](#)
- [Configuring OTN Interfaces on P1-PTX-24-10G-W-SFPP PIC on page 427](#)
- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Understanding Pre-FEC BER Monitoring and BER Thresholds on page 431](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)
- [Supported OTN Options on PTX Series Routers on page 437](#)
- [Understanding the P2-100GE-OTN PIC on page 446](#)
- [Configuring OTN Interfaces on P2-100GE-OTN PIC on page 450](#)

## Gigabit Ethernet OTN Options

---

The following example shows the configuration settings for Gigabit Ethernet OTN options:

```
[edit interfaces ge-fpc/pic/port]
otn-options {
  bytes (otn-options) transmit-payload-type value;
  fec (efec | gfec | gfec-sdfec | none );
  (is-ma | no-is-ma);
  (laser-enable | no-laser-enable);
  (line-loopback | no-line-loopback);
  (local-loopback | no-local-loopback);
  (odu-ttim-action-enable | no-odu-ttim-action-enable);
  (otu-ttim-action-enable | no-otu-ttim-action-enable);
  odu-delay-management {
    (bypass | no-bypass);
    (monitor-end-point | no-monitor-end-point);
    number-of-frames value;
    (no-start-measurement | start-measurement);
  }
  odu-signal-degrade {
    ber-threshold-clear value;
    ber-threshold-signal-degrade value;
    interval value;
  }
  (prbs | no-prbs);
```

```

preemptive-fast-reroute {
  (backward-frr-enable | no-backward-frr-enable);
  (signal-degrade-monitor-enable | no-signal-degrade-monitor-enable);
  odu-backward-frr-enable | no-odu-backward-frr-enable;
  odu-signal-degrade-monitor-enable | no-odu-signal-degrade-monitor-enable;
}
rate {
  (fixed-stuff-bytes | no-fixed-stuff-bytes);
  oc192;
  otu4;
  (pass-through | no-pass-through);
}
signal-degrade {
  ber-threshold-clear value;
  ber-threshold-signal-degrade value;
  interval value;
}
tca tca-identifier (enable-tca | no-enable-tca) (threshold number | threshold-24hrs
  number);
transport-monitoring;
trigger trigger-identifier;
tti tti-identifier;
}

```



**NOTE:** The Gigabit Ethernet interface and the XENPAK interface support the read/write overhead bytes only for the APS/PPC (bytes 0 through 3).

You can use the following show commands to view the OTN configuration:

- **show interfaces extensive**—See the [CLI Explorer](#) for command details.
- **show chassis hardware**—See the [CLI Explorer](#) for command details.
- **show chassis pic**—See the [CLI Explorer](#) for command details.

#### Related Documentation

- [10-Gigabit Ethernet OTN Options Configuration Overview on page 422](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## 10-Gigabit Ethernet OTN Options Configuration Overview

MX240, MX480, MX960, MX2010, MX2020, T320, T640, T1600, PTX3000, and PTX5000 routers support Optical Transport Network (OTN) interfaces, including the 10-Gigabit Ethernet DWDM OTN PIC, and provide ITU-T G.709 support. Use the **set otn-options** statement at the **[edit interfaces if-fpc/pic/port]** hierarchy level to configure the OTN options.

MX2020, MX2010, MX960, MX480, and MX240 routers support OTN interfaces on MPC5E and MPC6E. MPC5E-40G10G and MPC5EQ-10G40G support OTN on 10-Gigabit Ethernet interfaces but not on 40-Gigabit Ethernet interfaces. The OTN MIC MIC6-10G-OTN on MPC6E supports OTN on 10-Gigabit Ethernet interfaces on MX2020 and MX2010 routers. OTN support on the specified MX Series routers includes:

- International Telecommunications Union (ITU)-standard OTN performance monitoring and alarm management
- Transparent transport of 24 10-Gigabit Ethernet signals with optical channel data unit 2 (ODU2) and ODU2e framing on a per-port basis
- Pre-forward error correction (pre-FEC)-based bit error rate (BER). Fast reroute (FRR) uses the pre-FEC BER as an indication of the condition of an OTN link.

To configure the OTN options on the specified MX routers, use the **set otn-options** statement at the **[edit interfaces interfaceType-fpc/pic/port]** hierarchy level.

**Related  
Documentation**

- [otn-options on page 1098](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Understanding the P1-PTX-24-10G-W-SFPP PIC

Starting from Junos OS Release 14.2, a 24-port 10-Gigabit Ethernet OTN PIC—P1-PTX-24-10G-W-SFPP—is supported on the FPC-PTX-P1-A and FPC2-PTX-P1A FPCs in PTX5000 routers, and the FPC-SFF-PTX-P1-A and FPC-SFF-PTX-T FPCs in PTX3000 routers. The P1-PTX-24-10G-W-SFPP PIC provides twenty-four 10-Gigabit Ethernet interfaces, that are independently configurable in LAN PHY or WAN PHY framing mode or in optical channel transport unit in OTU2e, OTU1e, or OTU2 mode.

The following sections explain this PIC in detail:

- [Interface Features on page 423](#)
- [Layer 2 and Layer 3 Features on page 425](#)
- [OTN Alarms and Defects on page 426](#)
- [TCA Alarms on page 427](#)

### Interface Features

The following interface features are supported on the P1-PTX-24-10G-W-SFPP PIC:

- Twenty-four 10-Gigabit Ethernet interfaces, which are independently configurable in LAN PHY or WAN PHY mode or in OTU2e, OTU1e, or OTU2 signal mode. Each interface is terminated by means of a CFP2 transceiver.
- The interfaces are named with prefix *et*.
- Gigabit Ethernet local loopback.
- Link-level pause frames—You can halt the Ethernet interface from transmitting packets for a configured period of time.
- Interface hold timer and interface damping—You can set the **hold-time** statement (in milliseconds) to damp interface transitions.
- External clock.
- Nonstandard tag protocol identifier (TPID):

- For each 10-Gigabit Ethernet port, you can configure up to eight TPIDs by using the **tag-protocol-id** statement at the **[edit interfaces interface-name gigether-options ethernet-switch-profile]** hierarchy level.
- The **tag-protocol-id** statement can be configured only on the first port (port 0) of the PIC. If any other (nonzero) port has the **tag-protocol-id** configuration, the Routing Engine registers an error in the system log and the configuration is ignored.
- The **tag-protocol-id** statement configured on port 0 of the PIC also applies to the rest of the ports on that PIC.
- Generic forward error correction (GFEC), ultra forward error correction (UFEC), enhanced forward error correction (EFEC), and no-FEC modes of operation are supported.
- Diagnostics tools:
  - Line loopback
  - Local loopback
- Fast reroute (FRR)—Based on configurable pre-FEC, bit error rate (BER) is supported and is configured using the **ber-threshold-signal-degrade** statement at the **[edit interfaces interface-name otn-options signal-degrade]** hierarchy level.
- *jnx-ifotn.mib* and *otn-mib* as defined in RFC 3591. Note that according to Junos OS security standard, configurable parameters are not supported through SNMP. Only the *get* operation is available through SNMP.
- FEC statistics—corrected errors and corrected error ratio.
- OTN payload pseudorandom binary sequence (PRBS) generation and checking by enabling or disabling PRBS with the **prbs** or **no-prbs** statement at the **[edit interfaces interface-name otn-options]** hierarchy level.
- At the physical interface level, **flexible-ethernet-service**, **ethernet-ccc**, and **ethernet-tcc** encapsulations are supported. For **flexible-ethernet-service** encapsulation, the logical level supports **enet2**, **vlan-ccc**, and **vlan-tcc** encapsulations.
- At the logical interface level **dix**, **vlan-ccc**, and **vlan-tcc** encapsulations are supported.
- SNMP management of the PIC based on RFC 3591, Definitions of Managed Objects for the Optical Interface Type:
  - Set functionality
  - Juniper Networks Black-Link MIB
  - IFOTN MIB
  - Optics MIB
  - FRU MIB
- 15-minute and 1-day performance monitoring and historic statistics.
  - Near-end and far-end performance monitoring
  - Threshold-crossing alerts

- BER performance monitoring
- FEC performance monitoring
- Optical performance monitoring

The following features are not supported on the P1-PTX-24-10G-W-SFPP PIC:

- Source MAC learning for accounting
- MAC policing
- Physical interface-level encapsulations—**vlan-ccc**, **extended-vlan-ccc**, and **extended-vlan-tcc**
- Logical interface-level encapsulation—**vlan-vpls**
- VLAN rewrite for **ccc** encapsulation
- Per queue flow control
- Generic framing procedure-framed (GFP-F) mapping modes over OTN
- General communication channel (GCC)
- OTN interface-level Automatic Protection Switching (APS)
- Insertion, monitoring, and display of OTN header overhead byte
- Optical harness support
- Transport interface and state model (GR-1093)
- Trace tone support

## Layer 2 and Layer 3 Features

The following Layer 2 and Layer 3 features are supported on the P1-PTX-24-10G-W-SFPP PIC:

- MAC detect link up and link down based on local fault signal or remote fault signal.
- MAC statistics.
- Flow control.
- MAC oversized packet counters based on default MTU value or user-configured MTU value.
- Per-port destination address MAC filter.
- Per-port source address MAC filter.
- Per-physical interface source address MAC filter.
- Per logical interface source address MAC accounting.
- Maximum of 1000 source MAC filter per physical interface.
- Maximum of 32,000 filter terms to share across all filter features.

- Aggregated Ethernet supports 64 child links that can be configured using the **set chassis aggregated-devices maximum-links** configuration command.
- Maximum of 1024 logical interfaces on an aggregated Ethernet physical interface.
- Support for V LAN tagging, flexible VLAN tagging, and stacked VLAN tagging.
- LACP.
- Link protection.
- 802.3 ah OAM.
- 802.1 ag OAM.
- MPLS FRR.
- SNMP.
- Supports per-VLAN queuing (using Packet Forwarding Engine).

## OTN Alarms and Defects

The following OTN alarms and defects are supported on the P1-PTX-24-10G-W-SFPP PIC:

- LOS—Loss Of Signal
- LOF—Loss Of Frame
- LOM—Loss Of Multiframe
- SSF—Server Signal Failure
- TSF—Trail Signal Fail
- OTU-FEC-DEG—Forward Error Correction Degraded
- OTU-FEC-EXE—Excessive Errors, FEC\_FAIL from the transponder
- OTU-AIS—Alarm Indication Signal or all ones signal
- OTU-BDI—Backward Defect Identification
- OTU-IAE—Incoming Alignment Error
- OTU-BIAE—Backward Incoming Alignment Error
- OTU-TTIM—Destination Access Point Identifier [DAPI], Source Access Point Identifier [SAPI], or both mismatch from expected to received
- OTU-SD—Signal Degrade
- OTU-SF—Signal Fail
- CSF—Client Signal Failure
- ODU-LCK—(ODU lock triggers for PM [path monitoring])
- ODU-AIS—(alarm indication signal or all ones signal)
- ODU-OCI—(open connection error)

- ODU-BDI—(backward defect indication)
- ODU-IAE—(incoming alignment error)
- ODU-DAPI-TTIM—DAPI or DAPI/SAPI mismatch from expected to receive
- ODU-SAPI-TTIM—SAPI or DAPI/SAPI mismatch from expected to receive
- ODU-BEI—Backward Error Indication
- ODU-SSF—Server Signal Fail
- ODU-TSF—Trail Signal Fail
- ODU-SD—Signal Degrade
- ODU-SF—Signal Fail
- OPU-PTM—Payload Type Mismatch

## TCA Alarms

Threshold-crossing alarms (TCA) are alarms that are activated when a certain configurable threshold—near-end measurement threshold or far-end measurement threshold—is crossed and remains so until the end of the 15 minute interval for parameters such as OTU and ODU. The following alarms are supported:

- Background block error threshold (BBE)
- Errored seconds threshold (ES)
- Severely errored seconds threshold (SES)
- Unavailable seconds threshold (UAS)

### Related Documentation

- [Configuring OTN Interfaces on P1-PTX-24-10G-W-SFPP PIC on page 427](#)

## Configuring OTN Interfaces on P1-PTX-24-10G-W-SFPP PIC

Starting from Junos OS Release 14.2, a 24-port 10-Gigabit Ethernet OTN PIC—P1-PTX-24-10G-W-SFPP—is supported on the FPC-PTX-P1-A and FPC2-PTX-P1A FPCs in PTX5000 routers, and the FPC-SFF-PTX-P1-A and FPC-SFF-PTX-T FPCs in PTX3000 routers. To configure an OTN interface on the P1-PTX-24-10G-W-SFPP PIC, you must configure interface-specific options and the OTN-related options for the interface.

To configure the interface-specific options:

1. Go to the **[edit interface *interface-name*]** hierarchy level, where *interface-name* is in the *et-fpc/pic/port* format.
 

```
[edit]
user@host# edit interfaces interface-name
```
2. Configure the VLAN tagging option on the OTN interface to enable the reception and transmission of 802.1Q VLAN-tagged frames on the interface.

```
[edit interfaces interface-name ]
user@host# set vlan-tagging
```

3. Configure the maximum transmission unit (MTU) size in bytes for the interface.

```
[edit interfaces interface-name ]
user@host# set mtu bytes
```

4. Configure a VLAN ID for the interface.

```
[edit interfaces interface-name ]
user@host# set vlan-id number
```

5. Configure the family for the interface.

```
[edit interfaces interface-name ]
user@host# set family family-name
```

6. Configure an IP address for the interface.

```
[edit interfaces interface-name ]
user@host# set address address
```

To configure the OTN-related options on the interface:

1. Go to the `[edit interface interface-name otn-options]` hierarchy level:

```
[edit interfaces interface-name ]
user@host# edit otn-options
```

2. Enable the OTN mode as OTU2e, OTU1e, or OTU2 for the interface.

```
[edit interfaces interface-name otn-options]
user@host# set rate fixed-stuff-bytes|no-fixed-stuff-bytes|oc192
```



**NOTE:** `fixed-stuff-bytes` is for OTU2e rate, `no-fixed-stuff-bytes` is for OTU1e rate and `oc192` is for OTU2 rate. OTU2e and OTU1e rates are applicable for LAN PHY framing mode. OTU2 is applicable for WAN PHY framing mode. Framing mode is set through the `set interfaces framing` configuration statement.

3. Enable the laser on the OTN interface. The laser is disabled by default for all OTN interfaces.

```
[edit interfaces interface-name otn-options]
user@host# set laser-enable
```

4. Set an trail trace identifier for the source access point and for the destination access point for ODU and OTU on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set tti (odu-dapi | odu-expected-receive-dapi | odu-expected-receive-sapi
| odu-sapi | otu-dapi | otu-expected-receive-dapi | otu-expected-receive-sapi |
otu-sapi) tti-identifier
```

5. Ignore the trigger for the defect or set the hold time.



Configure the hold time for the defect trigger as:

- *up* with a value—Wait for the hold time delay before clearing the alarm when the defect is absent on the OTN interface.
- *down* with a value—Wait for the hold time delay before raising the alarm when the defect occurs for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set trigger (oc-lof | oc-lom | oc-los | oc-tsfc | odu-ais | odu-bdi | odu-bei |
    odu-iae | odu-lck | odu-oci | odu-sd | odu-ttim | opu-ptim | otu-ais | otu-bdi |
    otu-fec-deg | otu-fec-exe | otu-iae | otu-sd | otu-ttim) (hold-time (down value | up
    value) | ignore)
```

6. Enable the threshold crossing alarms for the OTN interface along with the trigger for the defect.

```
[edit interfaces interface-name otn-options]
user@host# set tca (odu-tca-bbe | odu-tca-es | odu-tca-ses | odu-tca-uas | otu-tca-bbe
    | otu-tca-es | otu-tca-ses | otu-tca-uas ) (enable-tca | no-enable-tca | threshold)
```

7. Set the OTN header bytes as a transmit payload type from 0 bytes through 255 bytes for the packets that are transmitted on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set bytes transmit-payload-type value
```

8. Configure the forward error correction (FEC) mode as Generic Forward Error Correction (GFEC), Enhanced Forward Error Correction (EFEC), Ultra Forward Error Correction (UFEC), or no-FEC (none) for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set fec (gfec | ufec | efec | none)
```

9. Enable a consequent action as listed in the ITU-T G.798 standard for ODU trail trace identifier mismatch (TTIM) on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set odu-ttim-action-enable
```

10. Enable a consequent action as listed in the ITU-T G.798 standard for OTU trail trace identifier mismatch (TTIM) on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set otu-ttim-action-enable
```

11. Configure the threshold value for signal degradation when an alarm needs to be raised. Configure the threshold value after signal degradation when the alarm needs to be cleared. When you configure the interval along with the **ber-threshold-signal-degrade *value*** statement, the bit error rate (BER) must stay above the signal degradation threshold for the configured interval after which the alarm is raised. When the interval is configured along with the **ber-threshold-clear *value*** statement, then BER must stay below the clear threshold for the configured interval after which the alarm is cleared.

```
[edit interfaces interface-name otn-options signal-degrade]
user@host# set ber-threshold-signal-degrade value
user@host# set ber-threshold-clear value
```

```
user@host# set interval value
```

12. Enable the following actions for the **preemptive-fast-reroute** statement:

- Backward FRR—Insert the local pre-FEC status into the transmitted OTN frames and monitor the received OTN frames for the pre-FEC status.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]  
user@host# set backward-frr-enable
```

- Monitoring of signal degradation of pre-FEC OTN frames.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]  
user@host# set signal-degrade-monitor-enable
```

**Related  
Documentation**

- [Understanding the P1-PTX-24-10G-W-SFPP PIC on page 423](#)
- [optics-options on page 1097](#)
- [otn-options on page 1098](#)
- [signal-degrade on page 1177](#)
- [preemptive-fast-reroute on page 1141](#)

---

## 100-Gigabit Ethernet OTN Options Configuration Overview

PTX Series routers support optical transport network (OTN) interfaces, including the 100-Gigabit DWDM OTN PIC, which supports:

- Transparent transport of two 100-Gigabit Ethernet signals with Optical Channel Transport Unit 4 (OTU4) framing.
- International Telecommunications Union (ITU)-standard OTN performance monitoring (PM) and alarm management.
- Dual polarization quadrature phase shift keying (DP-QPSK) modulation and soft-decision forward error correction (SD-FEC) for long haul and metro applications.
- Pre-forward error correction (pre-FEC)-based bit error rate (BER) monitoring. Pre-FEC BER monitoring uses the pre-FEC BER as an indication of the condition of an OTN link. See [“Understanding Pre-FEC BER Monitoring and BER Thresholds” on page 431](#) for more information.

For more information about the 100-Gigabit DWDM OTN PIC, see *100-Gigabit DWDM OTN PIC* in the *PTX Series Interface Module Reference*.

PTX Series routers also support the 100-Gigabit Ethernet OTN PIC (P2-100GE-OTN), which provides four 100-Gigabit Ethernet interfaces, independently configurable in LAN PHY framing mode or in optical channel transport unit 4 (OTU4) mode. See [“Understanding the P2-100GE-OTN PIC” on page 446](#) for more information.

See [“Supported OTN Options on PTX Series Routers” on page 437](#) for a comparison of the features supported on PTX Series OTN PICs.

MX2020, MX2010, MX960, MX480, and MX240 routers support OTN interfaces on MPC5E and MPC6E. MPC5E-100G10G and MPC5EQ-100G10G support 100-Gigabit Ethernet OTN interfaces and 10-Gigabit Ethernet OTN interfaces on MX240, MX480, and MX960 routers. The OTN MIC MIC6-100G-CFP2 on MPC6E supports OTN on 100-Gigabit Ethernet interfaces on MX2020 and MX2010 routers. OTN support on the specified MX Series routers includes:

- International Telecommunications Union (ITU)-standard OTN performance monitoring (PM) and alarm management
- Transparent transport of two 100-Gigabit Ethernet signals with optical channel transport unit 4 (OTU4) framing.
- Generic forward error correction (Generic FEC)

To configure the OTN options for PTX Series routers and specific MX Series routers, use the **set otn-options** statement at the **[edit interfaces interfaceType-fpc/pic/port]** hierarchy level.

Use the **set optics-options** statement at the **[edit interfaces interfaceType-fpc/pic/port]** hierarchy level to configure the optics options.

Use the **show interfaces extensive**, **show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port)**, and **show interfaces transport pm** commands to view optics and OTN PM information. To display the current time interval and clear the channel service unit (CSU) alarm and defect counters, use the **clear interfaces interval** command.

#### Related Documentation

- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [show interfaces diagnostics optics \(Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port\) on page 1528](#)
- [optics-options on page 1097](#)
- [otn-options on page 1098](#)

## Understanding Pre-FEC BER Monitoring and BER Thresholds

Optical transport network (OTN) interfaces on PTX Series Packet Transport Routers support monitoring the condition of an OTN link by using the pre-forward error correction (pre-FEC) bit error rate (BER). The following PICs support pre-FEC BER monitoring:

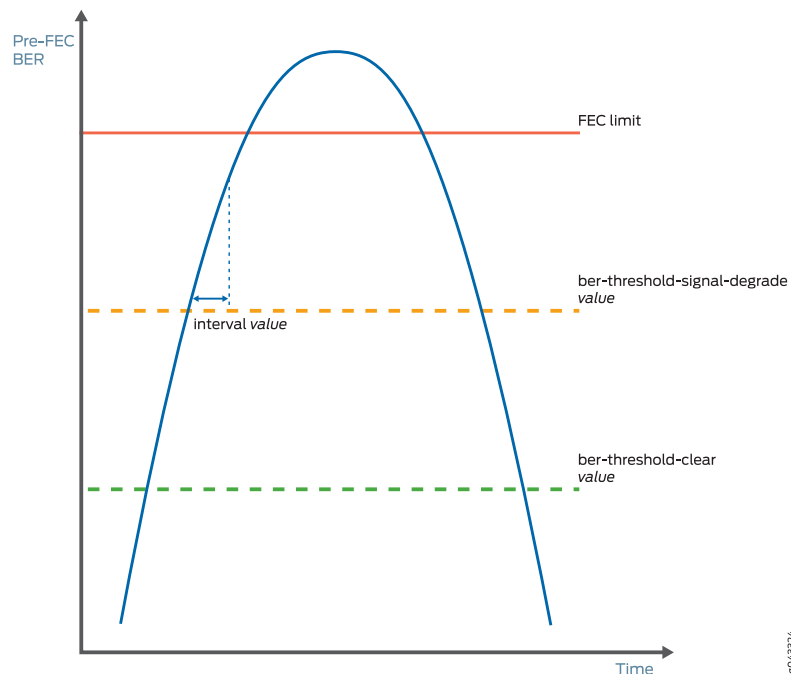
- P1-PTX-2-100G-WDM
- P2-100GE-OTN
- P1-PTX-24-10G-W-SFPP

The PICs use forward error correction (FEC) to correct bit errors in the received data. As long as the pre-FEC BER is below the FEC limit, all bit errors are successfully identified and corrected and, therefore, no packet loss occurs. The system monitors the pre-FEC

BER on each port. This gives an early warning of link degradation. By configuring an appropriate pre-FEC BER threshold and interval, you enable the PIC to take preemptive action before the FEC limit is reached. If this pre-FEC BER threshold logic is combined with MPLS fast reroute, then packet loss can be minimized or prevented.

You must specify both the signal degradation threshold (**ber-threshold-signal-degrade**) and the interval (**interval**) for the interface. The threshold defines the BER criteria for a signal degrade condition and the interval defines the minimum duration over which the BER must exceed the threshold before an alarm is raised. The relationship between the threshold and the interval is illustrated in [Figure 27 on page 432](#). After an alarm is raised, if the BER returns to a level below the threshold clear value (**ber-threshold-clear**), the alarm is cleared.

**Figure 27: Pre-FEC BER Monitoring**



With pre-FEC BER monitoring enabled, when the configured pre-FEC BER signal degrade threshold is reached, the PIC stops forwarding packets to the remote interface and raises an interface alarm. Ingress packets continue to be processed. If pre-FEC BER monitoring is used with MPLS fast reroute or another link protection method, then traffic is rerouted to a different interface.

You can also configure backward fast reroute to insert the local pre-FEC status into transmitted OTN frames, notifying the remote interface of signal degradation. The remote interface can use the information to reroute traffic to a different interface. If you use pre-FEC BER monitoring together with backward fast reroute, then notification of signal degradation and rerouting of traffic occurs in less time than that required through a Layer 3 protocol.

Include the `signal-degrade-monitor-enable` and `backward-frr-enable` statements at the `[edit interfaces interface-name otn-options preemptive-fast-reroute]` hierarchy level to enable pre-FEC BER monitoring and backward fast reroute.



**NOTE:** When you configure pre-FEC BER signal degrade monitoring, we recommend that you configure both the `signal-degrade-monitor-enable` and the `backward-frr-enable` statements.

You can also configure the pre-FEC BER thresholds that raise or clear a signal degrade alarm and the time interval for the thresholds. If the BER thresholds and interval are not configured, the default values are used.

When a received signal degrade alarm is active and backward fast reroute is enabled, a specific flag is inserted into the transmitted OTN overhead. The remote PIC at the opposite end of the link monitors the OTN overhead, thus enabling both ends to initiate traffic rerouting in the event of a signal degrade condition. When the signal degrade condition is cleared, the OTN overhead flag is returned to a normal state.

The pre-FEC BER signal degrade threshold value defines a specific amount of system margin relative to the BER correction limit (or FEC limit) of the PIC's receive FEC decoder. Each PIC has a set FEC limit—it is intrinsic to the FEC decoder implementation.



**NOTE:** The examples below use  $Q^2$ -factor measurements (also known as Q-factor).  $Q^2$ -factor is expressed in units of decibels relative to a  $Q^2$ -factor of zero (dBQ).  $Q^2$ -factor enables you to describe system margin in linear terms in contrast to BER values, which are nonlinear in nature. After you determine the thresholds, you must convert the threshold values from  $Q^2$ -factor to BER to enter them in the CLI by using scientific notation. BER can be converted to  $Q^2$ -factor by using the following equation:

$$Q^2\text{-factor} = 20 * \log_{10} (\text{sqrt}(2) * \text{erfcinv}(2 * \text{BER}))$$



**TIP:** To convert between  $Q^2$ -factor and BER in a spreadsheet program, you can approximate the values by using the following formulas:

- To calculate  $Q^2$ -factor:  

$$= 20 * \text{LOG10}(-\text{NORMSINV}(\text{BER}))$$
- To calculate BER:  

$$= 1 - \text{NORMSDIST}(10^{(0.05 * Q^2\text{-factor})})$$

Table 32 on page 434 shows the relationship between the fixed FEC limit, the configurable signal degrade threshold, and the configurable clear threshold for different PICs. In this example, approximately 1 dBQ of system margin has been set between the FEC limit, signal degrade threshold, and clear threshold.

Table 32: Example—Signal Degradate and Clear Threshold Values at 1 dBQ

PIC	FEC Type	FEC Limit		Signal Degradate Threshold		Clear Threshold	
		Q <sup>2</sup> -Factor	BER	Q <sup>2</sup> -Factor	BER	Q <sup>2</sup> -Factor	BER
P1-PTX-2-100G-WDM	SD-FEC	6.7 dBQ	1.5E-2	7.7 dBQ	7.5E-3	8.7 dBQ	3.0E-3
P2-100GE-OTN	G.709 GFEC	11.5 dBQ	8.0E-5	12.5 dBQ	1.1E-5	13.5 dBQ	1.0E-6
P1-PTX-24-10G-W-SFPP	G.975.11.4 (UFEC)	9.1 dBQ	2.2E-3	10.1 dBQ	6.9E-4	11.1 dBQ	1.6E-4
	G.975.11.7 (EFEC)	9.6 dBQ	1.3E-3	10.6 dBQ	3.6E-4	11.6 dBQ	7.5E-5
	G.709 GFEC	11.5 dBQ	8.0E-5	12.5 dBQ	1.1E-5	13.5 dBQ	1.0E-6

To adjust the signal degrade threshold, you must first decide on a new system margin target and then calculate the respective BER value (using the equation to convert from Q<sup>2</sup>-factor to BER). [Table 33 on page 434](#) shows the values if 3 dBQ of system margin relative to the FEC limit is required for the signal degrade threshold (while maintaining the clear threshold at 1 dBQ relative to the signal degrade threshold).



**NOTE:** The choice of system margin is subjective, as you might want to optimize your thresholds based on different link characteristics and fault tolerance and stability objectives. For guidance about configuring pre-FEC BER monitoring and BER thresholds, contact your Juniper Networks representative.

Table 33: Example—Signal Degradate and Clear Thresholds After Configuration

PIC	FEC Type	FEC Limit		Signal Degradate Threshold		Clear Threshold	
		Q <sup>2</sup> -Factor	BER	Q <sup>2</sup> -Factor	BER	Q <sup>2</sup> -Factor	BER
P1-PTX-2-100G-WDM	SD-FEC	6.7 dBQ	1.5E-2	9.7 dBQ	1.1E-3	10.7 dBQ	2.9E-4
P2-100GE-OTN	G.709 GFEC	11.5 dBQ	8.0E-5	14.5 dBQ	4.9E-8	15.5 dBQ	1.1E-9
P1-PTX-24-10G-W-SFPP	G.975.11.4 (UFEC)	9.1 dBQ	2.2E-3	12.1 dBQ	2.8E-5	13.1 dBQ	3.1E-6
	G.975.11.7 (EFEC)	9.6 dBQ	1.3E-3	12.6 dBQ	1.1E-5	13.6 dBQ	9.1E-7
	G.709 GFEC	11.5 dBQ	8.0E-5	14.5 dBQ	4.8E-8	15.5 dBQ	1.1E-9

Include the `ber-threshold-signal-degrade`, `ber-threshold-clear`, and `interval` statements at the `[edit interfaces interface-name otn-options signal-degrade]` hierarchy level to configure the BER thresholds and time interval.



**NOTE:** Configuring a high BER threshold for signal degradation and a long interval might cause the internal counter register to be saturated. Such a configuration is ignored by the router, and the default values are used instead. A system log message is logged for this error.

**Related Documentation**

- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## Configuring 100-Gigabit DWDM OTN PICs

PTX Series routers support optical transport network (OTN) interfaces, including the 100-Gigabit DWDM OTN PIC (P1-PTX-2-100G-WDM). See “[100-Gigabit Ethernet OTN Options Configuration Overview](#)” on page 430.

To configure the 100-Gigabit DWDM OTN PIC:

1. Configure the interface wavelength.

```
[edit interfaces interface-name optics-options]
user@host# set wavelength nm
```

See [wavelength](#).



**NOTE:** See *100-Gigabit DWDM OTN PIC Optical Interface Specifications* for a list of wavelengths supported by the P1-PTX-2-100G-WDM PIC.

2. Enable the laser.

```
[edit interfaces interface-name otn-options]
user@host# set laser-enable
```

3. (Optional) Set the tca.

```
[edit interfaces interface-name otn-options]
user@host# set tca tca-identifier (enable-tca | no-enable-tca) (threshold number |
threshold-24hrs number)
```

See [tca](#).

4. (Optional) Set the trace identifiers.

```
[edit interfaces interface-name otn-options]
user@host# set tti tti-identifier tti-identifier-name
```

See [tti](#).

5. (Optional) Specify defect triggers.

```
[edit interfaces interface-name otn-options]  
user@host# set trigger trigger-identifier
```

See [trigger](#).

6. (Optional) Enable VLAN tagging. See *Enabling VLAN Tagging*.
7. (Optional) Set the media MTU. See *OBSOLETE: Configuring the Media MTU*.
8. (Optional) Set the unit VLAN ID, family **inet**, and IP address.

```
[edit interfaces interface-name]  
user@host# set vlan-id number  
user@host# set family inet  
user@host# set address address
```

9. (Optional) Enable pre-FEC BER signal-degrade monitoring and backward fast reroute to monitor the pre-FEC BER status of the link and to insert the local pre-FEC status into transmitted OTN frames.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]  
user@host# set signal-degrade-monitor-enable  
user@host# set backward-frr-enable
```



See [signal-degrade-monitor-enable](#) and [backward-frr-enable](#).

10. (Optional) Configure the bit error rate (BER) thresholds for signal degradation used for monitoring the pre-forward error correction (pre-FEC) status of the OTN link.

- a. Set the BER signal-degrade threshold.

```
[edit interfaces interface-name otn-options signal-degrade]
user@host# set ber-threshold-signal-degrade value
```

- b. Set the BER threshold to clear signal-degrade alarms.

```
[edit interfaces interface-name otn-options signal-degrade]
user@host# set ber-threshold-clear value
```

- c. Set the time interval for signal-degrade collection. After the BER threshold for signal-degrade is crossed for ten consecutive intervals, an alarm is raised. If the BER threshold for signal-degrade clear is crossed for ten consecutive intervals, the alarm is cleared. For example, if the interval is configured as 10 ms, then the BER must stay above the signal degradation threshold for 100 ms (10 ms \* 10 intervals) for the alarm to be raised, or below the clear threshold for 100 ms for the alarm to be cleared.

```
[edit interfaces interface-name otn-options signal-degrade]
user@host# set interval value
```



**NOTE:** Configuring a high BER threshold for signal degradation and a long interval might cause the internal counter register to be saturated. Such a configuration is ignored by the router, and the default values are used instead. A system log message is logged for this error.

See [ber-threshold-signal-degrade](#), [ber-threshold-clear](#), and [interval](#).



**NOTE:** See “Understanding Pre-FEC BER Monitoring and BER Thresholds” on page 431 for more information about pre-FEC BER monitoring and determining BER threshold settings.

- Related Documentation
- [optics-options on page 1097](#)
  - [otn-options on page 1098](#)
  - [signal-degrade on page 1177](#)
  - [preemptive-fast-reroute on page 1141](#)

## Supported OTN Options on PTX Series Routers

Table 34 on page 438 lists the statements that are supported on 100-Gigabit Ethernet PICs on PTX Series routers at the `[edit interfaces interface-name otn-options]` hierarchy

level. Note that the term *NA* denotes that the statement is not applicable for that particular component:

**Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers**

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	P1-PTX-2-100G-WDM (PTX5000)
<code>bytes</code> ( <code>otn-options</code> )	<code>transmit-payload-</code> <code>type value</code>	13.2/13.3	14.1R2 14.2	14.2
<code>fec</code>	( <code>efec</code>   <code>gfec</code>   <code>gfec-sdfec</code>   <code>none</code>   <code>ufec</code> )	13.2/13.3	14.1R2 14.2 ( <code>gfec</code> , <code>none</code> )	14.2
<code>insert- odu-lck</code>	-	13.2/13.3	14.1R2 14.2	14.2
<code>insert- odu-oci</code>	-	13.2/13.3	14.1R2 14.2	14.2
<code>is-ma</code>   <code>no-is-ma</code>	-	13.2/13.3	NA	14.2
<code>laser-enable</code>   <code>no-laser-enable</code>	-	13.2/13.3	14.1R2 14.2	14.2
<code>line-loopback</code>   <code>no-line-loopback</code>	-	13.2/13.3	14.1R2 14.2	14.2
<code>local-loopback</code>   <code>no-local-loopback</code>	-	13.2/13.3	14.1R2 14.2	14.2
<code>odu-delay-management</code>	<code>bypass</code>   <code>no-bypass</code>	13.2/13.3	NA	NA
	<code>monitor-end-point</code>   <code>no-monitor-end-point</code>	13.2/13.3	NA	NA
	<code>number-of-frames value</code>	13.2/13.3	NA	NA
	<code>no-start-measurement</code>   <code>start-measurement</code>	13.2/13.3	NA	NA

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	PPTX240GWSFP (PTX5000)
odu-signal-degrade	ber-threshold-clear <i>value</i>	NA	14.1R2	NA
		NA	14.2	
	ber-threshold-signal-degrade <i>value</i>	NA	14.1R2	NA
		NA	14.2	
	interval <i>value</i>	NA	14.1R2	NA
			14.2	
odu-ttim-action-enable   no-odu-ttim-action-enable	-	13.2/13.3	14.1R2	14.2
			14.2	
otu-ttim-action-enable   no-otu-ttim-action-enable	-	13.2/13.3	14.1R2	14.2
			14.2	
prbs   no-prbs	-	13.2/13.3	14.1R2	14.2
			14.2	
preemptive-fast-reroute	backward-frr-enable   no-backward-frr-enable	13.2/13.3	14.1R2	14.2
			14.2	
	signal-degrade-monitor-enable   no-signal-degrade-monitor-enable	13.2/13.3	14.1R2	14.2
			14.2	
	odu-backward-frr-enable   no-odu-backward-frr-enable	NA	14.1R2	NA
			14.2	
	odu-signal-degrade-monitor-enable   no-odu-signal-degrade-monitor-enable	NA	14.1R2	NA
			14.2	

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	P1-PTX-2-100G-WDM (PTX5000)
rate	fixed-stuff-bytes   no-fixed-stuff-bytes	13.2/13.3	NA	14.2
	oc192	13.2/13.3	NA	14.2
	otu4	13.2/13.3	14.1R2 14.2	NA
	pass-through   no-pass-through	13.2/13.3	NA	NA
signal-degrade	ber-threshold-clear value	13.2/13.3	14.1R2 14.2	14.2
	ber-threshold-signal-degrade value	13.2/13.3	14.1R2 14.2	14.2
	interval value	13.2/13.3	14.1R2 14.2	14.2

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	PPTX240GWSFP (PTX5000)
tca	odu-tca-bbe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	odu-tca-bbe-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
	odu-tca-es (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	odu-tca-es-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
	odu-tca-ses (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	odu-tca-ses-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
	odu-tca-uas (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	otu-tca-bbe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
		13.2/13.3	NA	14.2

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	P1-PTX-2-100G-WDM (PTX5000)
	otu-tca-bbe-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)			
	otu-tca-es (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	otu-tca-es-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
	otu-tca-fec-ber (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	otu-tca-ses (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	otu-tca-ses-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
	otu-tca-uas (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	14.2	14.2
	otu-tca-uas-fe (enable-tca   no-enable-tca   threshold   threshold-24hrs)	13.2/13.3	NA	14.2
transport-monitoring	-	NA	NA	14.2

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	PPTX-2-100G-WSP (PTX5000)
<i>trigger</i> <i>trigger-identifier</i>	<i>oc-lof</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>oc-lom</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>oc-los</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>oc-tsf</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>oc-wavelength-lock</i> (hold-time (down   up)   ignore)	13.2/13.3	NA	14.2
	<i>odu-ais</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-bdi</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-bei</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-iae</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-lck</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-oci</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-sd</i> (hold-time (down   up)   ignore)	13.2/13.3	14.1R2 14.2	14.2
	<i>odu-ttim</i>	13.2/13.3		14.2

Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	P1/P2-100G-WSP (PTX5000)
			14.1R2	
			14.2	
<b>opu-ptim</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-ais</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-bdi</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-fec-deg</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-fec-exe</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-iae</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-sd</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2
<b>otu-ttim</b> (hold-time (down   up)   ignore)	13.2/13.3		14.1R2 14.2	14.2



Table 34: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (*continued*)

Statement	Options	P1-PTX-2-100G-WDM (PTX5000 / PTX3000)	P2-100GE-OTN (PTX5000)	PPTX-2-100G-WSP (PTX5000)
tti <i>tti-identifier</i>	odu-dapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	odu-expected- receive-dapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	odu-expected- receive-sapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	odu-sapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	otu-dapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	otu-expected- receive-dapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	otu-expected- receive-sapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2
	otu-sapi <i>identifier</i>	13.2/13.3	14.1R2 14.2	14.2

**Related Documentation**

- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## Understanding the P2-100GE-OTN PIC

---

Starting with Junos OS Release 14.1R2 and 14.2, a 100-Gigabit Ethernet OTN PIC—P2-100GE-OTN—is supported on the FPC2-PTX-P1A FPC in PTX5000 routers. The P2-100GE-OTN PIC provides 4-port 100-Gigabit Ethernet interfaces, which are independently configurable in LAN PHY framing mode or in optical channel transport unit 4 (OTU4) mode. Each interface is terminated by means of a CFP2 transceiver. The FPC2-PTX-P1A FPC supports two P2-100GE-OTN PICs, in which each 100-Gigabit Ethernet port is mapped to a Packet Forwarding Engine in the FPC.

Starting from Junos OS Release 15.1, you can perform the following on the P2-100GE-OTN PIC on PTX5000 routers:

- You can configure the interfaces on this PIC to be a part of the mixed rates and mixed mode aggregated Ethernet bundles. For information about mixed rates, see [“Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles” on page 129](#).
- Port-based pseudowire class of service (CoS) classification which includes Layer 3 IPv4, IPv6, and MPLS classification for interfaces with ethernet-ccc encapsulation.

The following sections explain this PIC in detail:

- [Interface Features on page 446](#)
- [Layer 2 and Layer 3 Features on page 448](#)
- [OTN Alarms and Defects on page 449](#)
- [TCA Alarms on page 449](#)

### Interface Features

The following interface features are supported on a P2-100GE-OTN PIC:

- 4-port 100-Gigabit Ethernet interfaces, which are independently configurable in LAN PHY framing mode or in OTU4 signal mode. Each interface is terminated by means of a CFP2 transceiver.
- Each port maps to a single Packet Forwarding Engine in the FPC2-PTX-P1A FPC.
- The interfaces are named with prefix *et*.
- Gigabit Ethernet local loopback.
- Link-level pause frames—You can halt the Ethernet interface from transmitting packets for a configured period of time.
- Interface hold timer and interface damping—You can set the **hold-time** statement (in milliseconds) to damp interface transitions.
- External clock
- Nonstandard tag protocol identifier (TPID):

- For each 100-Gigabit Ethernet port, you can configure up to eight TPIDs by using the **tag-protocol-id** statement at the **[edit interfaces interface-name gige-ethernet-switch-profile]** hierarchy level.
- The **tag-protocol-id** statement can be configured only on the first port (port 0) of the PIC. If any other (nonzero) port has the **tag-protocol-id** configuration, the Routing Engine registers an error in the system log and the configuration is ignored.
- The **tag-protocol-id** statement configured on port 0 of the PIC also applies to the rest of the ports on that PIC.
- The interface *Link Down* event always generates an interrupt; however, the interface *Link Up* event does not generate an interrupt. Therefore, the interface link-up event is detected during the 1-second PIC periodic polling process.
- Generic forward error correction (GFEC) (G.709) and no-FEC modes of operation.
- Diagnostics tools:
  - Line loopback
  - Local loopback
- Fast reroute (FRR)—Based on configurable pre-FEC, bit error rate (BER) is supported and is configured using the **ber-threshold-signal-degrade** statement at the **[edit interfaces interface-name otn-options signal-degrade]** hierarchy level.
- *jnx-ifotn.mib* and *otn-mib* as defined in RFC 3591. Note that according to Junos OS security standard, configurable parameters are not supported through SNMP. Only the *get* operation is available through SNMP.
- FEC statistics—corrected errors and corrected error ratio.
- OTN payload pseudorandom binary sequence (PRBS) generation and checking by enabling or disabling PRBS with the **prbs** or **no-prbs** statement at the **[edit interfaces interface-name otn-options]** hierarchy level.
- Optical channel data unit (ODU)-level delay measurement.
- At the physical interface level, **flexible-ethernet-service**, **ethernet-ccc**, and **ethernet-tcc** encapsulations are supported. For the **flexible-ethernet-service** encapsulation, the logical level supports **enet2**, **vlan-ccc**, and **vlan-tcc** encapsulations.
- At the logical interface level, **dix**, **vlan-ccc**, and **vlan-tcc** encapsulations are supported.
- Interoperability between 100-Gigabit Ethernet interfaces with CFP transceiver and 100-Gigabit Ethernet interfaces with CFP2 transceiver in LAN PHY framing mode and in OTU4 mode.

The following features are not supported on the P2-100GE-OTN PIC:

- Source MAC learning for accounting
- MAC policing
- Physical interface-level encapsulations—**vlan-ccc**, **extended-vlan-ccc**, and **extended-vlan-tcc**

- Logical interface-level encapsulation—**vlan-vpls**
- VLAN rewrite for **ccc** encapsulation
- Per-queue flow control
- Generic framing procedure-framed (GFP-F) mapping modes over OTN
- General communication channel (GCC)
- OTN interface-level Automatic Protection Switching (APS)
- Insertion, monitoring, and display of OTN header overhead byte
- Black link MIB for integration with transponders
- Optical harness support
- Transport interface and state model (GR-1093)
- Trace tone support
- 15-minute and 1-day performance monitoring counters and historic counters

## Layer 2 and Layer 3 Features

The following Layer 2 and Layer 3 features are supported on the P2-100GE-OTN PIC:

- MAC detect link up and link down based on local fault signal or remote fault signal.
- MAC statistics.
- Flow control.
- MAC oversized packet counters based on default MTU value or user-configured MTU value.
- Per-port destination address MAC filter.
- Per-port source address MAC filter.
- Per-physical interface source address MAC filter.
- Per-logical interface source address MAC accounting.
- Maximum of 1000 source MAC filter per physical interface.
- Maximum of 32,000 filter terms to share across all filter features.
- Aggregated Ethernet supports 64 child links that can be configured using the **set chassis aggregated-devices maximum-links** configuration command.
- Maximum of 1024 logical interfaces on an aggregated Ethernet physical interface.
- Support for VLAN tagging, flexible VLAN tagging, and stacked VLAN tagging.
- LACP.
- Link protection.
- 802.3 ah OAM.
- 802.1 ag OAM.

- MPLS FRR.
- SNMP.
- Supports per-VLAN queuing (using Packet Forwarding Engine).

## OTN Alarms and Defects

The following OTN alarms and defects are supported on the P2-100GE-OTN PIC:

- LOS—Loss Of Signal
- LOF—Loss Of Frame
- LOM—Loss Of Multiframe
- OTU—Degrade
- OTU—AIS
- OTU—IAE
- OTU—BDI
- OTU—TTIM
- OTU—Signal Degrade
- OTU—Signal Fail
- ODU—Signal Fail
- OTU-FEC—Degrade
- OTU-FEC—Excessive errors
- ODU—Signal Degrade
- ODU—AIS
- ODU—BDI
- ODU—OCI
- ODU—LCK
- ODU—TTIM
- OPU—PTM

## TCA Alarms

Threshold-crossing alarms (TCA) are alarms that are activated when a certain configurable threshold—near-end measurement threshold or far-end measurement threshold—is crossed and remains so until the end of the 15 minute interval for parameters such as OTU and ODU. The following alarms are supported:

- Background block error threshold (BBE)
- Errored seconds threshold (ES)

- Severely errored seconds threshold (SES)
- Unavailable seconds threshold (UAS)

**Related  
Documentation**

- [Configuring OTN Interfaces on P2-100GE-OTN PIC on page 450](#)

---

## Configuring OTN Interfaces on P2-100GE-OTN PIC

Starting with Junos OS Release 14.1R2 and 14.2R1, a 4-port 100-Gigabit Ethernet OTN PIC—P2-100GE-OTN—is supported on the FPC2-PTX-P1A FPC in PTX5000 routers. To configure an OTN interface on the P2-100GE-OTN PIC, you must configure interface-specific options and OTN-related options for the interface.

To configure the interface-specific options:

1. Go to the **[edit interface *interface-name*]** hierarchy level, where *interface-name* is in the *et-fpc/pic/port* format.  

```
[edit]
user@host# edit interfaces interface-name
```
2. Configure VLAN tagging on the OTN interface to enable the reception and transmission of 802.1Q VLAN-tagged frames on the interface.  

```
[edit interfaces interface-name ]
user@host# set vlan-tagging
```
3. Configure the maximum transmission unit (MTU) size in bytes for the interface.  

```
[edit interfaces interface-name ]
user@host# set mtu bytes
```
4. Configure a VLAN ID for the interface.  

```
[edit interfaces interface-name ]
user@host# set vlan-id number
```
5. Configure the family for the interface.  

```
[edit interfaces interface-name ]
user@host# set family family-name
```
6. Configure an IP address for the interface.  

```
[edit interfaces interface-name ]
user@host# set address address
```

To configure the OTN-related options on the interface:

1. Go to the **[edit interface *interface-name* otn-options]** hierarchy level:  

```
[edit]
user@host# edit interfaces interface-name otn-options
```
2. Enable the laser on the OTN interface. The laser is disabled by default for all OTN interfaces.  

```
[edit interfaces interface-name otn-options]
```

```
user@host# set laser-enable
```

3. Set an trail trace identifier for the source access point and for the destination access point for ODU and OTU on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set tti (odu-dapi | odu-expected-receive-dapi | odu-expected-receive-sapi
| odu-sapi | otu-dapi | otu-expected-receive-dapi | otu-expected-receive-sapi |
otu-sapi) tti-identifier
```

4. Ignore the trigger for the defect or set the hold time.

Configure the hold time for the defect trigger as:

- *up* with a value—Wait for the hold time delay before clearing the alarm when the defect is absent on the OTN interface.
- *down* with a value—Wait for the hold time delay before raising the alarm when the defect occurs for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set trigger (oc-lof | oc-lom | oc-los | oc-tsfc | odu-ais | odu-bdi | odu-bei |
odu-iae | odu-lck | odu-oci | odu-sd | odu-ttim | opu-ptim | otu-ais | otu-bdi |
otu-fec-deg | otu-fec-exe | otu-iae | otu-sd | otu-ttim) (hold-time (down value | up
value) | ignore)
```

5. Enable the threshold crossing alarms for the OTN interface along with the trigger for the defect.

- In Junos OS Release 14.1R2 only:

```
[edit interfaces interface-name otn-options trigger]
user@host# set tca (odu-tca-bbe | odu-tca-es | odu-tca-ses | odu-tca-uas |
otu-tca-bbe | otu-tca-es | otu-tca-ses | otu-tca-uas ) (enable-tca | no-enable-tca
| threshold)
```

- In Junos OS Release 14.2 and later:

```
[edit interfaces interface-name otn-options]
user@host# set tca (odu-tca-bbe | odu-tca-es | odu-tca-ses | odu-tca-uas |
otu-tca-bbe | otu-tca-es | otu-tca-ses | otu-tca-uas ) (enable-tca | no-enable-tca
| threshold)
```

6. Set the OTN header bytes as a transmit payload type from 0 bytes through 255 bytes for the packets that are transmitted on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set bytes transmit-payload-type value
```

7. Configure the forward error correction (FEC) mode as Generic Forward Error Correction (GFEC) or none for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set fec (gfec | none)
```

8. Enable line loopback or local host loopback for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set line-loopback
user@host# set local-loopback
```

9. Enable an ODU locked maintenance signal on the OTN interface to send the signal pattern 01010101.

```
[edit interfaces interface-name otn-options]
user@host# set insert-odu-lck
```

10. Enable an ODU open connection indication signal on the OTN interface to send the signal pattern 01100110.

```
[edit interfaces interface-name otn-options]
user@host# set insert-odu-oci
```

11. Enable a consequent action as listed in the ITU-T G.798 standard for ODU trail trace identifier mismatch (TTIM) on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set odu-ttim-action-enable
```

12. Enable a consequent action as listed in the ITU-T G.798 standard for OTU trail trace identifier mismatch (TTIM) on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set otu-ttim-action-enable
```

13. Configure the OTN payload pseudorandom binary sequence (PRBS) on the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set prbs
```

14. Configure the OTN mode as OTU4 for the OTN interface.

```
[edit interfaces interface-name otn-options]
user@host# set rate otu4
```

15. Configure the threshold value for signal degradation when an alarm needs to be raised. Configure the threshold value after signal degradation when the alarm needs to be cleared. When you configure the interval along with the **ber-threshold-signal-degrade value** statement, the bit error rate (BER) must stay above the signal degradation threshold for the configured interval after which the alarm is raised. When the interval is configured along with the **ber-threshold-clear value** statement, then BER must stay below the clear threshold for the configured interval after which the alarm is cleared.

```
[edit interfaces interface-name otn-options signal-degrade]
user@host# set ber-threshold-signal-degrade value
user@host# set ber-threshold-clear value
user@host# set interval value
```

16. Enable the following actions for the **preemptive-fast-reroute** statement:

- Backward FRR—Insert the local pre-FEC status into the transmitted OTN frames and monitor the received OTN frames for the pre-FEC status.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
user@host# set backward-frr-enable
```

- ODU backward FRR—Insert the ODU status into the transmitted OTN frames and monitor the received OTN frames for the ODU BER status.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
```



```
user@host# set odu-backward-frr-enable
```

- Monitoring of signal degradation of pre-FEC OTN frames.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
```

```
user@host# set signal-degrade-monitor-enable
```

- Monitoring of signal degradation of ODU BER in the received OTN frames.

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
```

```
user@host# set odu-signal-degrade-monitor-enable
```

17. Configure the following options for ODU BER signal degradation on the OTN interface:

- Configure the threshold for signal degradation for ODU BER when an alarm needs to be raised.

```
[edit interfaces interface-name otn-options odu-signal-degrade]
```

```
user@host# set ber-threshold-signal-degrade value
```

- Configure the threshold for ODU BER after signal degradation when the alarm needs to be cleared.

```
[edit interfaces interface-name otn-options odu-signal-degrade]
```

```
user@host# set ber-threshold-clear value
```

- When you configure the interval along with the **ber-threshold-signal-degrade *value*** statement, the ODU bit error rate (BER) must stay above the signal degradation threshold for the configured interval after which the alarm is raised. When the interval is configured along with the **ber-threshold-clear *value*** statement, then ODU BER must stay below the clear threshold for the configured interval after which the alarm is cleared.

```
[edit interfaces interface-name otn-options odu-signal-degrade]
```

```
user@host# set interval value
```

Related  
Documentation

- [optics-options on page 1097](#)
- [otn-options on page 1098](#)
- [signal-degrade on page 1177](#)
- [preemptive-fast-reroute on page 1141](#)



## CHAPTER 28

# Configuring Gigabit Ethernet Accounting and Policing

- [Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 455](#)
- [Configuring MAC Address Accounting on page 457](#)
- [MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview on page 458](#)
- [Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 459](#)
- [Configuring Layer 2 Overhead Accounting in Interface Statistics on page 461](#)
- [Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 462](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471](#)

### Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs

For Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), you can configure granular per-VLAN class-of-service (CoS) capabilities and extensive instrumentation and diagnostics on a per-VLAN and per-MAC address basis.

VLAN rewrite, tagging, and deleting enables you to use VLAN address space to support more customers and services.

VPLS allows you to provide a point-to-multipoint LAN between a set of sites in a VPN. Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router) are combined with VPLS to deliver metro Ethernet service.

For Gigabit Ethernet IQ2 and IQ2-E and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, you can apply Layer 2 policing to logical interfaces in the egress or ingress direction. Layer 2 policers are configured at the **[edit firewall]** hierarchy level. You can also control the rate of traffic sent or received on an interface by configuring a policer overhead at the **[edit chassis fpc slot-number pic slot-number]** hierarchy level.

Table 35 on page 456 lists the capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router).

**Table 35: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs**

Capability	Gigabit Ethernet IQ (SFP)	Gigabit Ethernet (SFP)
<b>Layer 2</b>		
802.3ad link aggregation	Yes	Yes
Maximum VLANs per port	384	1023
Maximum transmission unit (MTU) size	9192	9192
MAC learning	Yes	Yes
MAC accounting	Yes	Yes
MAC filtering	Yes	Yes
Destinations per port	960	960
Sources per port	64	64
Hierarchical MAC policers	Yes, premium and aggregate	No, aggregate only
Multiple TPID support and IP service for nonstandard TPIDs	Yes	Yes
Multiple Ethernet encapsulations	Yes	Yes
Dual VLAN tags	Yes	No
VLAN rewrite	Yes	No
<b>Layer 2 VPNs</b>		
VLAN CCC	Yes	Yes
Port-based CCC	Yes	Yes
Extended VLAN CCC Virtual Metropolitan Area Network (VMAN) Tag Protocol	Yes	Yes
<b>CoS</b>		
PIC-based egress queues	Yes	Yes

**Table 35: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs (*continued*)**

Capability	Gigabit Ethernet IQ (SFP)	Gigabit Ethernet (SFP)
Queued VLANs	Yes	No
VPLS	Yes	Yes

For more information about configuring VPLS, see the *Junos OS VPNs Library for Routing Devices* and the *Junos OS, Release 15.1*.

You can also configure CoS on logical IQ interfaces. For more information, see the *Class of Service Feature Guide for Routing Devices*.

#### Related Documentation

- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471](#)
- [Configuring MAC Address Accounting on page 457](#)
- *Configuring a Policer Overhead*
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring MAC Address Accounting

For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), for Gigabit Ethernet DPCs on MX Series routers, for 100-Gigabit Ethernet Type 5 PIC with CFP, and for MPC3E, MPC4E, MPC5E, MPC5EQ, and MPC6E MPCs, you can configure whether source and destination MAC addresses are dynamically learned.

To configure MAC address accounting on an individual Ethernet interface, include the **mac-learn-enable** statement at the **[edit interfaces *interface-name* together-options ethernet-switch-profile]** hierarchy level:

```
[edit interfaces interface-name together-options ethernet-switch-profile]
mac-learn-enable;
```

To configure MAC address accounting on an aggregated Ethernet interface, include the **mac-learn-enable** statement at the **[edit interfaces aex aggregated-ether-options ethernet-switch-profile]** hierarchy level:

```
[edit interfaces aex aggregated-ether-options ethernet-switch-profile]
mac-learn-enable;
```

To prohibit an interface from dynamically learning source and destination MAC addresses, do *not* include the **mac-learn-enable** statement.

To disable dynamic learning of the source and destination MAC addresses after it has been configured, you must delete **mac-learn-enable** from the configuration.



**NOTE:** MPCs support MAC address accounting for an individual interface or an aggregated Ethernet interface member link only after the interface has received traffic from the MAC source. If traffic is only exiting an interface, the MAC address is not learned and MAC address accounting does not occur.

**Related  
Documentation**

- [Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 455](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471](#)
- [Configuring a Policer Overhead](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview

---

Apart from the capability to compute MAC address statistics for dynamically learned static and destination MAC addresses on physical interfaces, starting in Junos OS Release 15.1, Junos OS enables you to configure source MAC (SMAC) address and destination MAC (DMAC) address-based accounting for MAC addresses that are dynamically learned on aggregated Ethernet (ae-) interfaces in routed mode. When you include the **mac-learn-enable** statement at the **[edit interfaces aex aggregated-ether-options ethernet-switch-profile]** hierarchy level, dynamic learning of source and destination MAC addresses is enabled. By default, this capability is disabled. When dynamic learning of MAC addresses is enabled for AE interfaces in routed mode, the MAC-filter settings are updated for each of the child links of the AE bundle interface. This feature provides for both the configuration of the **mac-learn-enable** filter and the display of SMAC and DMAC based accounting information on the aggregated interface in the output of the **show interfaces mac-database interface-name mac-address mac-address** command.

When this functionality is enabled, source and destination MAC addresses-based accounting is supported on the routed interfaces on MX Series routers with DPCs and MPCs. Support for mixed mode LAG interfaces is also available. This feature supports MAC address accounting for AE interfaces in routed mode (for inet family). Destination MAC-based accounting is supported only for MAC addresses dynamically learned at the ingress interface, including each individual child or member link of the AE bundle. This behavior occurs because MPCs do not support destination MAC address learning. As a result, if a packet exits a child link without passing in the ingress direction through that link, destination MAC (DMAC) accounting for this packet occurs at the child link level and this data is not available at the aggregate level. Dynamic learning of MAC addresses can be supported on only the AE interface or on selective individual member links. MAC learning support on the bundle depends on the capability of individual member links. If a link in the bundle does not contain the capability to support MAC learning or accounting, it is disabled on the AE bundle.

The MAC data for the aggregated bundle is displayed by collecting data from individual child links. This data is collected when the command to display the MAC database is

triggered from the CLI. This method of data collection implies that based on the number of child links and the size of the MAC database, the time take to display the database differs. This approach to obtain the current snapshot of the MAC database from the currently active child links is used instead of maintaining a database at the Routing Engine because of the dynamic nature of the MAC database and the overhead required to maintain the database information in synchronization with all the child Packet Forwarding Engines. A difference in the DMAC-based accounting for packets generated from the Routing Engine (packets sent in the host path). On DPCs, these packets are accounted in egress direction (Output Packet/Byte count), whereas on MPCs, these packets are not accounted because DMAC learning is not supported. This difference in behavior also occurs between child links on DPCs and MPCs. Because this feature to enable dynamic learning is related to collecting MAC database statistics from child links based on the command issued from the CLI, there is a impact on the time it takes to display the data on the console based on the size of the MAC database and the number of child-links spread across different FPCs. The limit on the maximum number of MAC addresses that can be learned from an interface does not apply to this dynamic learning of MAC addresses functionality.

Related Documentation • [mac-learn-enable on page 1048](#)

## Accounting of the Layer 2 Overhead Attribute in Interface Statistics

On MX Series and T Series routers, you can configure the logical interface statistics to include the Layer 2 overhead size (header and trailer bytes) for both ingress and egress interfaces. Both the transit and total statistical information are computed and displayed for each logical interface. This functionality is supported on 1-Gigabit, 10-Gigabit, 40-Gigabit, and 100-Gigabit Ethernet interfaces on Dense Port Concentrators (DPCs), and Modular Port Concentrators (MPCs) on MX Series routers. Also, this feature is supported on 10-Gigabit Ethernet interfaces on MX Series routers with MPC4E. However, this feature is not supported on MX Series routers with MPC3E. You can also configure the capability to compute the Layer 2 overhead bytes in interface statistics on Type-3, Type-4 and Type-5 Flexible Port Concentrators (FPCs) on T Series routers. To enable the Layer 2 overhead bytes to be counted in the interface statistics at the PIC level, you must use the **account-layer2-overhead** statement at the **[edit chassis fpc slot-number pic pic-number]** hierarchy level.

If you configure this capability, all the Layer 2 header details (Layer 2 header and cyclic redundancy check [CRC]) based on the Layer 2 encapsulation configured for an interface are calculated and displayed in the logical interface statistics for ingress and egress interfaces in the output of the **show interfaces interface-name** commands. For logical interfaces, the **Input bytes** and **Output bytes** fields under the Traffic statistics section in the output of the **show interfaces interface-name <detail | extensive>** command include the Layer 2 overhead of the packets. For logical interfaces, the Input rate and Output rate fields under the Traffic statistics section in the output of the **show interfaces interface-name <media | statistics>** command include the Layer 2 overhead of the packets. For logical interfaces, the values for the newly added **Egress account overhead** and **Ingress account overhead** fields display the Layer 2 overhead size for transmitted and received packets respectively.

The input and output octets at the logical interface configured on the PIC includes all the Layer 2 headers. All the logical interfaces on the PIC, including the ae and the non-ae interfaces, are processed for Layer 2 overhead accounting for the arriving and exiting packets. This method of operation impacts the transit statistics that are primarily used for subscriber accounting and billing purposes in customer networks.

Table 36 on page 460 lists the adjustment bytes that are counted based on the encapsulation on the logical interface over the Ethernet interface, when you enable accounting of Layer 2 overhead in interface statistics at the PIC level. The values for the adjustment bytes that are listed for all types of encapsulation are the same for DPCs and MPCs, with the only exception being for the VLAN CCC adjustment value. On DPCs, the VLAN CCC adjustment value is -4 bytes and on MPCs, the VLAN CCC adjustment value is +4 bytes.

**Table 36: Adjustment Bytes for Logical Interfaces over Ethernet Interfaces**

Encapsulation Type on Logical Interfaces	Number of Adjustment Bytes	Description
Ethernet DIXv2 (IP datagrams over Ethernet)	18	Untagged (includes CRC)
Ethernet DIXv2 (IP datagrams over Ethernet)	22	Single-tagged (includes CRC)
Ethernet DIXv2 (IP datagrams over Ethernet)	26	Double-tagged (includes CRC)
VLAN Bridge	4	CRC
VLAN CCC	4	CRC
VLAN TCC	18	Untagged (includes CRC)
VLAN TCC	22	Single-tagged (includes CRC)
VLAN TCC	26	Double-tagged (includes CRC)
VLAN VPLS	4	CRC

### Guidelines for Configuring the Computation of Layer 2 Overhead in Interface Statistics

Keep the following points in mind when you configure the computation of Layer 2 overhead in interface statistics:

- When you configure a native VLAN ID on a logical interface, the Layer 2 header adjustment for input statistics is different for tagged and untagged packets. For such interfaces, if you configure the setting to account for Layer 2 overhead, incorrect statistics might be displayed.
- An untagged packet is considered as a tagged packet and an additional 4 bytes are appended to the counter values displayed in the output of the **show interface** command.



- The computed statistics might not be completely accurate in scenarios where the packets are dropped after they have been included in the interface statistics, but before the packets reach the destination.
- Label-switched interface (LSI) statistics on the ingress direction of interfaces do not include the Layer 2 overhead bytes because this functionality of accounting Layer 2 overhead is not supported for such LSI interfaces.
- Layer 2 overhead accounting is not supported for inline service (si) interfaces.
- The total statistics of interfaces do not indicate the complete Layer 2 adjusted statistics. This behavior occurs because the total statistics count is the sum of transit and local statistics. Only the transit statistics are adjusted for Layer 2 and the local statistics are not adjusted for Layer 2.
- Statistics on ae interfaces are calculated in the same manner as non-ae interfaces.
- Adjustment bytes are applicable only for transit statistics that are displayed for logical interfaces.
- For physical interfaces, the adjustment bytes for transit traffic and the non-adjusted bytes for local or protocol-specific traffic are combined and displayed in the output of the **show interfaces** command. (Segregation is not possible.)
- Layer 2 overhead accounting can be enabled at both PIC level and logical interface level.
- When the **account-layer2-overhead** statement is configured, the Layer 2 overhead size in both input and output statistics is accounted for in Dense Port Concentrator (DPCs) and Modular Port Concentrator (MPCs).
- This **account-layer2-overhead** configuration now supports Layer 2 accounting for the Ethernet bridge encapsulation.
- The Layer 2 overhead bytes in interface statistics are saved across a unified ISSU or a graceful Routing Engine switchover (GRES) operation.

**Related  
Documentation**

- [Configuring Layer 2 Overhead Accounting in Interface Statistics on page 461](#)
- [Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 462](#)
- [account-layer2-overhead on page 857](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Layer 2 Overhead Accounting in Interface Statistics

---

This topic contains sections that describe the configuration of Layer 2 overhead accounting for interface statistics at the PIC level and logical interface level.

Layer 2 overhead accounting can be enabled at both PIC level and logical interface level through configuration. By default, the physical interface and logical interface statistics do not account for Layer 2 overhead size (header and trailer) in both input and output statistics.

When the **account-layer2-overhead** statement is configured, the Layer 2 overhead size in both input and output statistics is accounted for in the Dense Port Concentrator (DPCs) and the Modular Port Concentrator (MPCs). This **account-layer2-overhead** configuration now supports Layer 2 accounting for the Ethernet bridge encapsulation.

- [Enabling the Accounting of Layer 2 Overhead in Interface Statistics at the PIC Level on page 462](#)

## Enabling the Accounting of Layer 2 Overhead in Interface Statistics at the PIC Level

You can configure the **account-layer2-overhead** statement at the **edit chassis fpc slot-number pic pic-number** hierarchy level to enable accounting of Layer 2 overhead bytes in the ingress and egress interface statistics at the PIC level.



**CAUTION:** If you modify the setting for accounting of Layer 2 overhead bytes at the PIC level, the PIC is rebooted, causing all of the physical and logical interfaces to be deleted and readded on the PIC. Due to this behavior, we recommend that you exercise caution while using this feature.

The computation method of Layer 2 overhead on different interface types is as follows:

- For Ethernet interfaces, all the Layer 2 headers are counted.
- For non-Ethernet interfaces, the Frame Relay, PPP, or Cisco HDLC headers are counted, while the bit or byte stuffing headers are excluded.

To enable accounting of Layer 2 overhead at the PIC level for ingress and egress traffic on interfaces:

1. Access a DPC or an MPC-occupied slot and the PIC where the interface is to be enabled.

```
[edit chassis]
user@host# edit fpc slot-number pic number
```

2. Specify the Layer 2 overhead value in bytes that is the octet adjustment per packet added to the total octet count for ingress and egress traffic on all the interfaces in the PIC.

```
[edit chassis fpc slot-number pic number]
user@host# set account-layer2-overhead
```

---

## Verifying the Accounting of Layer 2 Overhead in Interface Statistics

**Purpose** Display information about the Layer 2 overhead bytes that are counted in interface statistics for egress and ingress traffic on Ethernet interfaces.

**Action** • To display information about the Layer 2 overhead bytes that are counted in interface statistics:



**NOTE:** For physical and logical interfaces, the values displayed for the Input rate and Output rate fields under the Traffic statistics section include the Layer 2 overhead of the packets.

user@host> show interfaces ge-5/2/0 statistics detail

```
Physical interface: ge-5/2/0, Enabled, Physical link is Up
  Interface index: 146, SNMP ifIndex: 519, Generation: 149
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, BPDU Error: None, MAC-REWRITE Error: None,
  Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:61:d9:74, Hardware address: 00:1d:b5:61:d9:74
  Last flapped   : 2009-11-11 11:24:00 PST (09:23:08 ago)
  Statistics last cleared: 2009-11-11 17:50:58 PST (02:56:10 ago)
  Traffic statistics:
    Input bytes   :          271524          0 bps
    Output bytes  :       37769598       352 bps
    Input packets :          3664          0 pps
    Output packets:       885790          0 pps
  IPv6 transit statistics:
    Input bytes   :           0
    Output bytes  :      16681118
    Input packets :           0
    Output packets:      362633
  Multicast statistics:
    IPV4 multicast statistics:
      Input bytes   :      112048          0 bps
      Output bytes  :     20779920          0 bps
      Input packets :       1801          0 pps
      Output packets:     519498          0 pps
    IPV6 multicast statistics:
      Input bytes   :      156500          0 bps
      Output bytes  :     16681118          0 bps
      Input packets :       1818          0 pps
      Output packets:     362633          0 pps
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runt: 0, Policed discards: 0, L3 incompletes: 0, L2 channel
  errors: 0,
    L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0, FIFO errors: 0, HS link
  CRC errors: 0, MTU errors: 0,
    Resource errors: 0
  Egress queues: 8 supported, 4 in use
  Queue counters:
    Queued packets  Transmitted packets  Dropped packets
    0 best-effort   882558          882558          0
    1 expedited-fo    0              0              0
    2 assured-forw    0              0              0
    3 network-cont   3232          3232          0
  Active alarms   : None
  Active defects  : None
```

```

Logical interface ge-5/2/0.0 (Index 71) (SNMP ifIndex 573) (Generation 135)
Flags: SNMP-Traps 0x4000 Encapsulation: ENET2
Egress account overhead: 100
Ingress account overhead: 90
Traffic statistics:
  Input bytes :          271524
  Output bytes :        37769598
  Input packets:          3664
  Output packets:       885790
IPv6 transit statistics:
  Input bytes :           0
  Output bytes :       16681118
  Input packets:          0
  Output packets:      362633
Local statistics:
  Input bytes :          271524
  Output bytes :       308560
  Input packets:          3664
  Output packets:       3659
Transit statistics:
  Input bytes :           0                0 bps
  Output bytes :      37461038            0 bps
  Input packets:          0                0 pps
  Output packets:     882131              0 pps
IPv6 transit statistics:
  Input bytes :           0
  Output bytes :       16681118
  Input packets:          0
  Output packets:      362633
Multicast statistics:
  IPV4 multicast statistics:
    Input bytes :          112048            0 bps
    Output bytes :      20779920            0 bps
    Input packets:          1801            0 pps
    Output packets:     519498             0 pps
  IPV6 multicast statistics:
    Input bytes :          156500            0 bps
    Output bytes :      16681118            0 bps
    Input packets:          1818            0 pps
    Output packets:     362633             0 pps
Protocol inet, MTU: 1500, Generation: 151, Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 40.40.40.0/30, Local: 40.40.40.2, Broadcast: 40.40.40.3, Generation: 167
Protocol inet6, MTU: 1500, Generation: 152, Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: ::40.40.40.0/126, Local: ::40.40.40.2
Generation: 169
  Addresses, Flags: Is-Preferred
    Destination: fe80::/64, Local: fe80::21d:b5ff:fe61:d974
Protocol multiservice, MTU: Unlimited, Generation: 171
Generation: 153, Route table: 0
  Policers: Input: __default_arp_policer__

```

- Related Documentation**
- [Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 459](#)
  - [Configuring Layer 2 Overhead Accounting in Interface Statistics on page 461](#)
  - [show interfaces \(Gigabit Ethernet\) on page 1579](#)

- *show interfaces statistics*
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Gigabit Ethernet Policers

- Overview on page 465
- Configuring a Policer on page 466
- Specifying an Input Priority Map on page 466
- Specifying an Output Priority Map on page 467
- Applying a Policer on page 468
- Configuring MAC Address Filtering on page 469
- Example: Configuring Gigabit Ethernet Policers on page 470

### Overview

On Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), you can define rate limits for premium and aggregate traffic received on the interface. These policers allow you to perform simple traffic policing without configuring a firewall filter. First you configure the Ethernet policer profile, next you classify ingress and egress traffic, then you can apply the policer to a logical interface.

For Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), the policer rates you configure can be different than the rates on the Packet Forward Engine. The difference results from Layer 2 overhead. The PIC accounts for this difference.



#### NOTE:

On MX Series routers with Gigabit Ethernet or Fast Ethernet PICs, the following considerations apply:

- Interface counters do not count the 7-byte preamble and 1-byte frame delimiter in Ethernet frames.
- In MAC statistics, the frame size includes MAC header and CRC before any VLAN rewrite/imposition rules are applied.
- In traffic statistics, the frame size encompasses the L2 header without CRC after any VLAN rewrite/imposition rule.

For information on understanding Ethernet frame statistics, see the *MX Series Layer 2 Configuration Guide*.

## Configuring a Policer

To configure an Ethernet policer profile, include the **ethernet-policer-profile** statement at the **[edit interfaces *interface-name* gigether-options ethernet-switch-profile]** hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-switch-profile]
ethernet-policer-profile {
  policer cos-policer-name {
    aggregate {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
    premium {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
  }
}
```

In the Ethernet policer profile, the aggregate-priority policer is mandatory; the premium-priority policer is optional.

For aggregate and premium policers, you specify the bandwidth limit in bits per second. You can specify the value as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000). There is no absolute minimum value for bandwidth limit, but any value below 61,040 bps will result in an effective rate of 30,520 bps. The maximum bandwidth limit is 4.29 Gbps.

The maximum burst size controls the amount of traffic bursting allowed. To determine the burst-size limit, you can multiply the bandwidth of the interface on which you are applying the filter by the amount of time you allow a burst of traffic at that bandwidth to occur:

$$\text{burst size} = \text{bandwidth} \times \text{allowable time for burst traffic}$$

If you do not know the interface bandwidth, you can multiply the maximum MTU of the traffic on the interface by 10 to obtain a value. For example, the burst size for an MTU of 4700 would be 47,000 bytes. The burst size should be at least 10 interface MTUs. The maximum value for the burst-size limit is 100 MB.

## Specifying an Input Priority Map

An input priority map identifies ingress traffic with specified IEEE 802.1p priority values, and classifies that traffic as premium.

If you include a premium-priority policer, you can specify an input priority map by including the **ieee802.1p premium** statement at the **[edit interfaces *interface-name* gigether-options ethernet-policer-profile input-priority-map]** hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-policer-profile input-priority-map]
ieee802.1p premium [ values ];
```

The priority values can be from 0 through 7. The remaining traffic is classified as nonpremium (or aggregate). For a configuration example, see [“Example: Configuring Gigabit Ethernet Policers” on page 470](#).



**NOTE:** On IQ2 and IQ2-E interfaces and MX Series interfaces, when a VLAN tag is pushed, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the VLAN or VLANs being pushed. If the original packet is untagged, the IEEE bits of the VLAN or VLANs being pushed are set to 0.

## Specifying an Output Priority Map

An output priority map identifies egress traffic with specified queue classification and packet loss priority (PLP), and classifies that traffic as premium.

If you include a premium-priority policer, you can specify an output priority map by including the **classifier** statement at the **[edit interfaces *interface-name* gigether-options ethernet-policer-profile output-priority-map]** hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-policer-profile
  output-priority-map]
classifier {
  premium {
    forwarding-class class-name {
      loss-priority (high | low);
    }
  }
}
```

You can define a forwarding class, or you can use a predefined forwarding class. [Table 37 on page 467](#) shows the predefined forwarding classes and their associated queue assignments.

**Table 37: Default Forwarding Classes**

Forwarding Class Name	Queue
best-effort	Queue 0
expedited-forwarding	Queue 1
assured-forwarding	Queue 2
network-control	Queue 3

For more information about CoS forwarding classes, see the *Class of Service Feature Guide for Routing Devices*. For a configuration example, see [“Example: Configuring Gigabit Ethernet Policers” on page 470](#).

## Applying a Policer

On all MX Series Router interfaces, Gigabit Ethernet IQ, IQ2, and IQ2-E PICs, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), you can apply input and output policers that define rate limits for premium and aggregate traffic received on the logical interface. Aggregate policers are supported on Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router).

These policers allow you to perform simple traffic policing without configuring a firewall filter.

To apply policers to specific source MAC addresses, include the **accept-source-mac** statement:

```
accept-source-mac {
  mac-address mac-address {
    policer {
      input cos-policer-name;
      output cos-policer-name;
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

You can specify the MAC address as *nn:nn:nn:nn:nn:nn* or *nnnn.nnnn.nnnn*, where *n* is a hexadecimal number. You can configure up to 64 source addresses. To specify more than one address, include multiple **mac-address** statements in the logical interface configuration.



**NOTE:** On untagged Gigabit Ethernet interfaces you should not configure the **source-address-filter** statement at the [edit interfaces *ge-fpc/pic/port* *gether-options*] hierarchy level and the **accept-source-mac** statement at the [edit interfaces *ge-fpc/pic/port* *gether-options* unit *logical-unit-number*] hierarchy level simultaneously. If these statements are configured for the same interfaces at the same time, an error message is displayed.

On tagged Gigabit Ethernet interfaces you should not configure the **source-address-filter** statement at the [edit interfaces *ge-fpc/pic/port* *gether-options*] hierarchy level and the **accept-source-mac** statement at the [edit interfaces *ge-fpc/pic/port* *gether-options* unit *logical-unit-number*] hierarchy level with an identical MAC address specified in both filters. If these statements are configured for the same interfaces with an identical MAC address specified, an error message is displayed.





**NOTE:** If the remote Ethernet card is changed, the interface does not accept traffic from the new card because the new card has a different MAC address.

The MAC addresses you include in the configuration are entered into the router's MAC database. To view the router's MAC database, enter the **show interfaces mac-database interface-name** command:

```
user@host> show interfaces mac-database interface-name
```

In the **input** statement, list the name of one policer template to be evaluated when packets are received on the interface.

In the **output** statement, list the name of one policer template to be evaluated when packets are transmitted on the interface.



**NOTE:** On IQ2 and IQ2-E PIC interfaces, the default value for maximum retention of entries in the MAC address table has changed, for cases in which the table is not full. The new holding time is 12 hours. The previous retention time of 3 minutes is still in effect when the table is full.

You can use the same policer one or more times.

If you apply both policers and firewall filters to an interface, input policers are evaluated before input firewall filters, and output policers are evaluated after output firewall filters.

## Configuring MAC Address Filtering

You cannot explicitly define traffic with specific source MAC addresses to be rejected; however, for Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), and for Gigabit Ethernet DPCs on MX Series routers, you can block all incoming packets that do not have a source address specified in the **accept-source-mac** statement. For more information about the **accept-source-mac** statement, see [“Applying a Policer” on page 468](#).

To enable this blocking, include the **source-filtering** statement at the **[edit interfaces interface-name gigether-options]** hierarchy level:

```
[edit interfaces interface-name gigether-options]
source-filtering;
```

For more information about the **source-filtering** statement, see [“Configuring MAC Address Filtering for Ethernet Interfaces” on page 13](#).

To accept traffic even though it does not have a source address specified in the **accept-source-mac** statement, include the **no-source-filtering** statement at the **[edit interfaces interface-name gigether-options]** hierarchy level:

```
[edit interfaces interface-name gigether-options]
no-source-filtering;
```

## Example: Configuring Gigabit Ethernet Policers

- [Example on page 470](#)
- [Example Configuration on page 470](#)

---

### Example

This example illustrates the following:

- Configure interface **ge-6/0/0** to treat priority values 2 and 3 as premium. On ingress, this means that IEEE 802.1p priority values **2** and **3** are treated as premium. On egress, it means traffic that is classified into queue 0 or 1 with PLP of low and queue 2 or 3 with PLP of high, is treated as premium.
- Define a policer that limits the premium bandwidth to 100 Mbps and burst size to 3 k, and the aggregate bandwidth to 200 Mbps and burst size to 3 k.
- Specify that frames received from the MAC address **00:01:02:03:04:05** and the VLAN ID **600** are subject to the policer on input and output. On input, this means frames received with the source MAC address **00:01:02:03:04:05** and the VLAN ID 600 are subject to the policer. On output, this means frames transmitted from the router with the destination MAC address **00:01:02:03:04:05** and the VLAN ID **600** are subject to the policer.

---

### Example Configuration

```
[edit interfaces]
ge-6/0/0 {
  together-options {
    ether-switch-profile {
      ether-policer-profile {
        input-priority-map {
          ieee-802.1p {
            premium [ 2 3 ];
          }
        }
        output-priority-map {
          classifier {
            premium {
              forwarding-class best-effort {
                loss-priority low;
              }
              forwarding-class expedited-forwarding {
                loss-priority low;
              }
              forwarding-class assured-forwarding {
                loss-priority high;
              }
              forwarding-class network-control {
                loss-priority high;
              }
            }
          }
        }
      }
    }
  }
}
```

```

    policer policer-1 {
      premium {
        bandwidth-limit 100m;
        burst-size-limit 3k;
      }
      aggregate {
        bandwidth-limit 200m;
        burst-size-limit 3k;
      }
    }
  }
}
unit 0 {
  accept-source-mac {
    mac-address 00:01:02:03:04:05 {
      policer {
        input policer-1;
        output policer-1;
      }
    }
  }
}
}

```

#### Related Documentation

- [Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 455](#)
- [Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471](#)
- [Configuring MAC Address Accounting on page 457](#)
- [Configuring a Policer Overhead](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Gigabit Ethernet Two-Color and Tricolor Policers

- [Overview on page 471](#)
- [Configuring a Policer on page 473](#)
- [Applying a Policer on page 473](#)
- [Example: Configuring and Applying a Policer on page 474](#)

### Overview

For Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M Series and T Series routers, you can configure two-color and tricolor marking policers and apply them to logical interfaces to prevent traffic on the interface from consuming bandwidth inappropriately.

Networks police traffic by limiting the input or output transmission rate of a class of traffic on the basis of user-defined criteria. Policing traffic allows you to control the maximum rate of traffic sent or received on an interface and to partition a network into multiple priority levels or classes of service.

Policers require you to apply a burst size and bandwidth limit to the traffic flow, and set a consequence for packets that exceed these limits—usually a higher loss priority, so that packets exceeding the policer limits are discarded first.

Juniper Networks router architectures support three types of policer:

- Two-color policer—A two-color policer (or “policer” when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit in some way, or simply discard them. A policer is most useful for metering traffic at the port (physical interface) level.
- Single-rate tricolor marking (single-rate TCM)—A single-rate tricolor marking policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured committed information rate (CIR), committed burst size (CBS), and excess burst size (EBS).

Traffic is classified into the following three categories:

- Green—Burst size of the packets that arrive is less than the sum of the configured CIR and CBS.
- Red—Burst size of the packets that arrive is greater than the sum of the configured CIR and EBS.
- Yellow—Burst size of the packets that arrive is greater than the CBS but less than the EBS.

Single-rate TCM is most useful when a service is structured according to packet length and not peak arrival rate.

- Two-rate Tricolor Marking (two-rate TCM)—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured CIR and peak information rate (PIR), along with their associated burst sizes, the CBS and EBS.

Traffic is classified into the following three categories:

- Green—Burst size of the packets that arrive is less than the sum of the configured CIR and CBS.
- Red—Burst size of the packets that arrive is greater than the sum of the configured PIR and EBS.
- Yellow—Traffic does not belong to either the green or the red category.

Two-rate TCM is most useful when a service is structured according to arrival rates and not necessarily packet length.



**NOTE:** Unlike policing (described in “[Configuring Gigabit Ethernet Policers](#)” on page 465), configuring two-color policers and tricolor marking policers requires that you configure a firewall filter.

---

## Configuring a Policer

Two-color and tricolor marking policers are configured at the **[edit firewall]** hierarchy level.

A tricolor marking policer polices traffic on the basis of metering rates, including the CIR, the PIR, their associated burst sizes, and any policing actions configured for the traffic.

To configure tricolor policer marking, include the **three-color-policer** statement with options at the **[edit firewall]** hierarchy level:

```
[edit firewall]
three-color-policer name {
  action {
    loss-priority high {
      then discard;
    }
  }
  single-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    excess-burst-size bytes;
  }
  two-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    peak-information-rate bps;
    peak-burst-size bytes;
  }
}
```

For more information about configuring tricolor policer markings, see the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide for Routing Devices* and the *Class of Service Feature Guide for Routing Devices*.

## Applying a Policer

Apply a two-color policer or tricolor policer to a logical interface to prevent traffic on the interface from consuming bandwidth inappropriately. To apply two-color or tricolor policers, include the **layer2-policer** statement:

```
layer2-policer {
  input-policer policer-name;
  input-three-color policer-name;
  output-policer policer-name;
  policer-name;
}
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces interface-name unit logical-unit-number]**

- `[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]`

Use the **input-policer** statement to apply a two-color policer to received packets on a logical interface and the **input-three-color** statement to apply a tricolor policer. Use the **output-policer** statement to apply a two-color policer to transmitted packets on a logical interface and the **output-three-color** statement to apply a tricolor policer. The specified policers must be configured at the **[edit firewall]** hierarchy level. For each interface, you can configure a three-color policer or two-color input policer or output policers—you cannot configure both a three-color policer and a two-color policer.

### Example: Configuring and Applying a Policer

Configure tricolor policers and apply them to an interface:

```
[edit firewall]
three-color-policer three-color-policer-color-blind {
  logical-interface-policer;
  two-rate {
    color-blind;
    committed-information-rate 1500000;
    committed-burst-size 150;
    peak-information-rate 3;
    peak-burst-size 300;
  }
}
three-color-policer three-color-policer-color-aware {
  logical-interface-policer;
  two-rate {
    color-aware;
    committed-information-rate 1500000;
    committed-burst-size 150;
    peak-information-rate 3;
    peak-burst-size 300;
  }
}
[edit interfaces ge-1/1/0]
unit 1 {
  layer2-policer {
    input-three-color three-color-policer-color-blind;
    output-three-color three-color-policer-color-aware;
  }
}
```

Configure a two-color policer and apply it to an interface:

```
[edit firewall]
policer two-color-policer {
  logical-interface-policer;
  if-exceeding {
    bandwidth-percent 90;
    burst-size-limit 300;
  }
  then loss-priority-high;
}
```

```
[edit interfaces ge-1/1/0]
unit 2 {
  layer2-policer {
    input-policer two-color-policer;
    output-policer two-color-policer;
  }
}
```

**Related  
Documentation**

- [Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 455](#)
- [Configuring Gigabit Ethernet Policers on page 465](#)
- [Configuring MAC Address Accounting on page 457](#)
- *Configuring a Policer Overhead*
- *Ethernet Interfaces Feature Guide for Routing Devices*





## CHAPTER 29

# Configuring Gigabit Ethernet Autonegotiation

- [Gigabit Ethernet Autonegotiation Overview on page 477](#)
- [Configuring Gigabit Ethernet Autonegotiation on page 477](#)

## Gigabit Ethernet Autonegotiation Overview

---

Autonegotiation is enabled by default on all Gigabit Ethernet and Tri-Rate Ethernet copper interfaces. However, you can explicitly enable autonegotiation to configure remote fault options manually.



### NOTE:

- When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled.
- On ACX Series Universal Access Routers, when the autonegotiation is disabled, the speed has to be explicitly configured to 10–100 Mbps.
- On T4000 routers, the auto-negotiation command is ignored for interfaces other than Gigabit Ethernet.

### Related Documentation

- [Configuring Gigabit Ethernet Autonegotiation](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Gigabit Ethernet Autonegotiation

---

- [Configuring Gigabit Ethernet Autonegotiation with Remote Fault on page 478](#)
- [Configuring Flow Control on page 478](#)
- [Configuring Autonegotiation Speed on MX Series Routers on page 478](#)
- [Displaying Autonegotiation Status on page 478](#)

## Configuring Gigabit Ethernet Autonegotiation with Remote Fault

To configure explicit autonegotiation and remote fault, include the **auto-negotiation** statement and the **remote-fault** option at the **[edit interfaces ge-fpc/pic/port gether-options]** hierarchy level.

```
[edit interfaces ge-fpc/pic/port gether-options]
(auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
local-interface-offline>
```

## Configuring Flow Control

To enable flow control, include the **flow-control** statement at the **[edit interfaces ge-fpc/pic>/port gether-options]** hierarchy level. For more information, see [“Configuring Flow Control” on page 11](#).

## Configuring Autonegotiation Speed on MX Series Routers

MX Series routers with Combo Line Rate DPCs and Tri-Rate Copper SFPs support autonegotiation of speed. The autonegotiation specified interface speed is propagated to CoS, routing protocols, and other system components. Half-duplex mode is not supported.

MX Series routers with IQ2 PICs connected to other devices require matching auto-negotiation configurations for both the PIC and for the device in order to achieve link up.

To specify the autonegotiation speed, use the **speed (auto | 1Gbps | 100Mbps | 10Mbps)** statement at the **[edit interfaces ge-fpc/pic/port]** hierarchy level.

To set port speed negotiation to a specific rate, set the port speed to **1Gbps**, **100Mbps**, or **10Mbps**. If the negotiated speed and the interface speed do not match, the link will not be brought up.

If you set the autonegotiation speed **auto** option, then the port speed is negotiated.

You can disable auto MDI/MDIX using the **no-auto-mdix** statement at the **[edit interfaces ge-fpc/pic/port gether-options]** hierarchy level.

Use the **show interfaces ge-fpc/pic/port brief** command to display the auto negotiation of speed and auto MDI/MDIX states.

## Displaying Autonegotiation Status

To display Gigabit Ethernet interface details, including the autonegotiation status, use the operational mode command **show interfaces ge- fpc/pic/port extensive**.

[Table 38 on page 479](#) and [Table 39 on page 481](#) provide information about the autonegotiation status on local and remote routers with fiber interfaces. The status of the link and LED can vary depending on the level of autonegotiation set and the transmit and receive fiber status.

Table 38: Mode and Autonegotiation Status (Local)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Default	Green	UP	Complete
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	Default	Red	DOWN	
ON	ON	Default	Green	UP	No-autonegotiation
ON	OFF	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	Default	Green	UP	
ON	ON	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Red	DOWN	
ON	ON	Explicit	Green	UP	Complete
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	
ON	ON	Explicit	Green	UP	No-autonegotiation
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Green	UP	
OFF	OFF	Explicit	Red	DOWN	

Table 38: Mode and Autonegotiation Status (Local) (*continued*)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Explicit	Red	DOWN	
ON	ON	Explicit+RFI-Offline	Green	UP	Complete
OFF	ON	Explicit+RFI-Offline	Red	DOWN	
OFF	OFF	Explicit+RFI-Offline	Red	DOWN	
ON	ON	Explicit+RFI-Offline	Red	DOWN	
ON	ON	Explicit+RFI-Offline	Green	UP	No-autonegotiation
ON	OFF	Explicit+RFI-Offline	Red	DOWN	
OFF	ON	Explicit+RFI-Offline	Green	UP	
OFF	OFF	Explicit+RFI-Offline	Red	DOWN	
ON	ON	Explicit+RFI-Offline	Red	DOWN	
ON	ON	Explicit+RFI-Offline	Red	DOWN	Complete
ON	OFF	Explicit+RFI-Offline	Red	DOWN	
OFF	ON	Explicit+RFI-Online	Red	DOWN	
OFF	OFF	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Green	UP	No-autonegotiation*
ON	OFF	Explicit+RFI-Online	Red	DOWN	
OFF	ON	Explicit+RFI-Online	Green	UP	
OFF	OFF	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Green	UP	
ON	ON	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Red	DOWN	Complete
ON	OFF	Explicit+RFI-Online	Red	DOWN	
OFF	ON	Explicit+RFI-Online	Red	DOWN	

Table 38: Mode and Autonegotiation Status (Local) (*continued*)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
OFF	OFF	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Red	DOWN	
ON	ON	Explicit+RFI-Online	Green	UP	Complete

Table 39: Mode and Autonegotiation Status (Remote)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Default	Green	UP	Complete
ON	ON	Default	Red	DOWN	
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	Explicit	Green	UP	Complete
ON	ON	Explicit	Red	DOWN	
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	Complete
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	

Table 39: Mode and Autonegotiation Status (Remote) (*continued*)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Explicit+RFI-Offline	Red	DOWN	Complete
ON	OFF	Explicit+RFI-Offline	Red	DOWN	
OFF	ON	Explicit+RFI-Offline	Red	DOWN	
OFF	OFF	Explicit+RFI-Offline	Red	DOWN	
ON	ON	Explicit+RFI-Online	Green	UP	Complete
ON	ON	Explicit+RFI-Online	Red	DOWN	
ON	OFF	Explicit+RFI-Online	Red	DOWN	
OFF	ON	Explicit+RFI-Online	Red	DOWN	
OFF	OFF	Explicit+RFI-Online	Red	DOWN	

- Related Documentation**
- [Gigabit Ethernet Autonegotiation Overview on page 477](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## CHAPTER 30

# Stacking and Rewriting Gigabit Ethernet VLAN Tags

- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 484](#)
- [Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames on page 487](#)
- [Configuring Tag Protocol IDs \(TPIDs\) on PTX Series Packet Transport Routers on page 488](#)
- [Configuring Stacked VLAN Tagging on page 489](#)
- [Configuring Dual VLAN Tags on page 489](#)
- [Configuring Inner and Outer TPIDs and VLAN IDs on page 490](#)
- [Stacking a VLAN Tag on page 493](#)
- [Stacking Two VLAN Tags on page 494](#)
- [Removing a VLAN Tag on page 494](#)
- [Removing the Outer and Inner VLAN Tags on page 495](#)
- [Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag on page 496](#)
- [Rewriting the VLAN Tag on Tagged Frames on page 496](#)
- [Rewriting a VLAN Tag on Untagged Frames on page 497](#)
- [Rewriting a VLAN Tag and Adding a New Tag on page 501](#)
- [Rewriting the Inner and Outer VLAN Tags on page 502](#)
- [Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags on page 502](#)
- [Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 509](#)
- [Understanding swap-by-poppush on page 511](#)
- [Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag on page 511](#)

## Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview

---

Stacking and rewriting VLAN tags allows you to use an additional (outer) VLAN tag to differentiate between customer edge (CE) routers that share one VLAN ID. A frame can be received on an interface, or it can be internal to the system (as a result of the `input-vlan-map` statement).

On IQ2 interfaces, 10-Gigabit Ethernet LAN/WAN PIC, 40-Gigabit Ethernet MIC, 100-Gigabit Ethernet MIC, IQ2-E interfaces, and MX Series interfaces, when a VLAN tag is pushed, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the VLAN or VLANs being pushed. If the original packet is untagged, the IEEE bits of the VLAN or VLANs being pushed are set to 0.



**NOTE:** When swap-by-poppush is configured on the interface, when a VLAN tag is swapped, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the VLAN being swapped. If swap-by-poppush is not configured on the interface, the VLAN IEEE 802.1p bits of the of the VLAN being swapped remains same.

You can stack and rewrite VLAN tags on the following interfaces:

- Gigabit Ethernet
- Gigabit Ethernet IQ
- 10-Gigabit Ethernet LAN/WAN PIC
- 40-Gigabit Ethernet MIC
- 100-Gigabit Ethernet MIC
- Gigabit Ethernet IQ2 and IQ2-E
- 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, and MX Series router Gigabit Ethernet Interfaces
- Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces with the VLAN encapsulation type configured to support Layer 2 tunneling protocols such as circuit cross-connect (CCC) or virtual private LAN service (VPLS) (as described in “[802.1Q VLANs Overview](#)” on page 236)

**Related  
Documentation**

- [802.1Q VLANs Overview on page 236](#)
- [Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 484](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Stacking and Rewriting Gigabit Ethernet VLAN Tags

You can configure rewrite operations to stack (**push**), remove (**pop**), or rewrite (**swap**) tags on single-tagged frames and dual-tagged frames. If a port is not tagged, rewrite operations are not supported on any logical interface on that port.

You can configure the following VLAN rewrite operations:

- **pop**—Remove a VLAN tag from the top of the VLAN tag stack. The outer VLAN tag of the frame is removed.
- **pop-pop**—For Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces, remove both the outer and inner VLAN tags of the frame.



- **pop-swap**—For Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces, remove the outer VLAN tag of the frame, and replace the inner VLAN tag of the frame with a user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.
- **push**—Add a new VLAN tag to the top of the VLAN stack. An outer VLAN tag is pushed in front of the existing VLAN tag.
- **push-push**—For Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces, push two VLAN tags in front of the frame.
- **swap-push**—For Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces, replace the outer VLAN tag of the frame with a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.
- **swap-swap**—For Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces, replace both the inner and the outer VLAN tags of the incoming frame with a user-specified VLAN tag value.

You configure VLAN rewrite operations for logical interfaces in the input VLAN map for incoming frames and in the output VLAN map for outgoing frames. To configure the input VLAN map, include the **input-vlan-map** statement:

```
input-vlan-map {
  ...interface-specific configuration...
}
```

To configure the output VLAN map, include the **output-vlan-map** statement:

```
output-vlan-map {
  ...interface-specific configuration...
}
```

You can include both statements at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number*]

The type of VLAN rewrite operation permitted depends upon whether the frame is single-tagged or dual-tagged. [Table 40 on page 485](#) shows supported rewrite operations and whether they can be applied to single-tagged frames or dual-tagged frames. The table also indicates the number of tags being added or removed during the operation.

**Table 40: Rewrite Operations on Untagged, Single-Tagged, and Dual-Tagged Frames**

Rewrite Operation	Untagged	Single-Tagged	Dual-Tagged	Number of Tags
pop	No	Yes	Yes	–1
push	Sometimes	Yes	Yes	+1

Table 40: Rewrite Operations on Untagged, Single-Tagged, and Dual-Tagged Frames (*continued*)

Rewrite Operation	Untagged	Single-Tagged	Dual-Tagged	Number of Tags
swap	No	Yes	Yes	0
push-push	Sometimes	Yes	Yes	+2
swap-push	No	Yes	Yes	+1
swap-swap	No	No	Yes	0
pop-pop	No	No	Yes	-2
pop-swap	No	No	Yes	-1

The rewrite operations **push** and **push-push** can be valid in certain circumstances on frames that are not tagged. For example, a single-tagged logical interface (interface 1) and a dual-tagged logical interface (interface 2) have the following configurations:

```

Interface 1 [edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop;
}
output-vlan-map {
  push;
}

Interface 2 [edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop-pop;
}
output-vlan-map {
  push-push;
}

```

When a frame is received on the interface as a result of the **input-vlan-map** operation, the frame is not tagged. As it goes out of the second interface, the **output-vlan-map** operation **push-push** is applied to it. The resulting frame will be dual-tagged at the logical interface output.

Depending on the VLAN rewrite operation, you configure the rewrite operation for the interface in the input VLAN map, the output VLAN map, or in both the input VLAN map and the output VLAN map. [Table 41 on page 487](#) shows what rewrite operation combinations you can configure. “None” means that no rewrite operation is specified for the VLAN map.

Table 41: Applying Rewrite Operations to VLAN Maps

Input VLAN Map	Output VLAN Map								
	none	push	pop	swap	push-push	swap-push	swap-swap	pop-pop	swap-pop
none	Yes	No	No	Yes	No	No	Yes	No	No
push	No	No	Yes	No	No	No	No	No	No
pop	No	Yes	No	No	No	No	No	No	No
swap	Yes	No	No	Yes	No	No	No	No	No
push-push	No	No	No	No	No	No	No	Yes	No
swap-push	No	No	No	No	No	No	No	No	Yes
swap-swap	Yes	No	No	No	No	No	Yes	No	No
pop-pop	No	No	No	No	Yes	No	No	No	No
pop-swap	No	No	No	No	No	Yes	No	No	No

You must know whether the VLAN rewrite operation is valid and is applied to the input VLAN map or the output VLAN map. You must also know whether the rewrite operation requires you to include statements to configure the inner and outer TPIDs and inner and outer VLAN IDs in the input VLAN map or output VLAN map. For information about configuring inner and outer TPIDs and inner and outer VLAN IDs, see [“Configuring Inner and Outer TPIDs and VLAN IDs” on page 490](#).

#### Related Documentation

- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)
- [Understanding swap-by-poppush on page 511](#)
- [swap-by-poppush on page 1192](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames

For Gigabit Ethernet IQ interfaces, aggregated Ethernet with Gigabit Ethernet IQ interfaces, Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), and MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, you can configure frames with particular TPIDs to be processed as tagged frames. To do this, you specify up to eight IEEE 802.1Q TPID values per port; a frame with any of the specified TPIDs is processed as a tagged frame; however, with IQ2 and IQ2-E interfaces, only the first four IEEE 802.1Q TPID values per port are supported. To configure the TPID values, include the **tag-protocol-id** statement:

**tag-protocol-id** [ *tpids* ];

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **gigether-options** **ethernet-switch-profile**]
- [edit interfaces *interface-name* **aggregated-ether-options** **ethernet-switch-profile**]

All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* **gigether-options** **ethernet-switch-profile** **tag-protocol-id** [ *tpids* ]] or [edit interfaces *interface-name* **aggregated-ether-options** **ethernet-switch-profile** **tag-protocol-id** [ *tpids* ]] hierarchy level.

**Related  
Documentation**

- [Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483](#)
- [aggregated-ether-options on page 872](#)
- [ethernet-switch-profile on page 955](#)
- [gigether-options on page 980](#)
- [tag-protocol-id on page 1199](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Tag Protocol IDs (TPIDs) on PTX Series Packet Transport Routers

This topic describes how to configure the TPIDs expected to be sent or received on a particular VLAN for PTX Series Packet Transport Routers.

For other types of Juniper Networks Ethernet PICs, you could configure 8 TPIDs per port. However, the PTX Series Packet Transport Routers use MTIP and TL to classify a specific TPID and Ethernet type. For MTIP, you can configure a maximum of 8 TPIDs for each MAC chip.

As a consequence, you can specify the **tag-protocol-id** configuration statement only for the first port (0) of a PTX Series Ethernet PIC. If you configure **tag-protocol-id** statements on the other port, the configuration is ignored and a system error is recorded.

For example, the following is a supported configuration:

```
[edit interfaces et-2/0/0]
gigether-options {
  ethernet-switch-profile {
    tag-protocol-id [0x8100 0x9100];
  }
}
```

The **tag-protocol-id** configuration statement supports up to eight TPIDs on port 0 of a given Ethernet PIC. All eight TPIDs are populated to the two MTIPs and TLs associated with the Ethernet PIC.

**Related  
Documentation**

- [Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames on page 487](#)
- [Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 241](#)

## Configuring Stacked VLAN Tagging

To configure stacked VLAN tagging for all logical interfaces on a physical interface:

1. In configuration mode, go to the **[edit interfaces interface-name]** hierarchy level.

```
[edit]
user@host# edit interfaces interface-name
```

2. Include the **stacked-vlan-tagging** statement.

```
[edit interfaces interface-name]
user@host# set stacked-vlan-tagging
```

If you include the **stacked-vlan-tagging** statement in the configuration, you must configure dual VLAN tags for all logical interfaces on the physical interface. For more information, see “Stacking a VLAN Tag” on page 493.

### Related Documentation

- [stacked-vlan-tagging on page 1186](#)
- [Stacking a VLAN Tag on page 493](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Dual VLAN Tags

To configure dual VLAN tags on a logical interface, include the **vlan-tags** statement:

```
vlan-tags inner <tpid.>vlan-id outer <tpid.>vlan-id;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces interface-name unit logical-unit-number]**
- **[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]**

The outer tag VLAN ID range is from 1 through 511 for normal interfaces, and from 512 through 4094 for VLAN CCC or VLAN VPLS interfaces. The inner tag is not restricted.

You must also include the **stacked-vlan-tagging** statement in the configuration. See “Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags” on page 502.

### Related Documentation

- [unit on page 1228](#)
- [Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags on page 502](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Inner and Outer TPIDs and VLAN IDs

For some rewrite operations, you must configure the inner or outer tag-protocol identifier (TPID) values and inner or outer virtual local area network identifier (VLAN ID) values. These values can be applied to either the input VLAN map or the output VLAN map.

1. On Ethernet IQ, IQ2, and IQ2-E interfaces; on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces; and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, to configure the inner TPID, include the **inner-tag-protocol-id** statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

```
user@host# set inner-tag-protocol-id tpid;
```

2. For the inner VLAN ID, include the **inner-vlan-id** statement. For the outer TPID, include the **tag-protocol-id** statement. For the outer VLAN ID, include the **vlan-id** statement at the [edit interfaces *interface-name* **unit** *logical-unit-number*] hierarchy level or at the [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number*] hierarchy level.

```
input-vlan-map {
  (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
  inner-tag-protocol-id tpid;
  inner-vlan-id number;
  tag-protocol-id tpid;
  vlan-id number;
}
output-vlan-map {
  (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
  inner-tag-protocol-id tpid;
  inner-vlan-id number;
  tag-protocol-id tpid;
  vlan-id number;
}
```

3. For aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces, include the **tag-protocol-id** statement for the outer TPID. For the outer VLAN ID, include the **vlan-id** statement at the [edit interfaces *interface-name* **unit** *logical-unit-number*] hierarchy level or at the [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number*] hierarchy level.

```
input-vlan-map {
  (pop | push | swap);
  tag-protocol-id tpid;
```

```

    vlan-id number;
}
output-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}

```

The VLAN IDs you define in the input VLAN maps are stacked on top of the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see [“802.1Q VLANs Overview” on page 236](#).

All TPIDs you include in input and output VLAN maps must be among those you specify at the `[edit interfaces interface-name giether-options ethernet-switch-profile tag-protocol-id [ tpids ]]` hierarchy level or `[edit interfaces interface-name aggregated-ether-options ethernet-switch-profile tag-protocol-id [ tpids ]]` hierarchy level. For more information, see [“Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames” on page 487](#).

[Table 42 on page 491](#) and [Table 43 on page 492](#) specify when these statements are required. [Table 42 on page 491](#) indicates valid statement combinations for rewrite operations for the input VLAN map. “No” means the statement must not be included in the input VLAN map for the rewrite operation. “Optional” means the statement may be optionally specified for the rewrite operation in the input VLAN map. “Any” means that you must include the **vlan-id** statement, **tag-protocol-id** statement, **inner-vlan-id** statement, or **inner-tag-protocol-id** statement.

**Table 42: Rewrite Operations and Statement Usage for Input VLAN Maps**

Rewrite Operation	Input VLAN Map Statements			
	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
push	Optional	Optional	No	No
pop	No	No	No	No
swap	Any	Any	No	No
push-push	Optional	Optional	Optional	optional
swap-push	Optional	Optional	Any	Any
swap-swap	Optional	Optional	Any	Any
pop-swap	No	No	Any	Any
pop-pop	No	No	No	No

[Table 43 on page 492](#) indicates valid statement combinations for rewrite operations for the output VLAN map. “No” means the statement must not be included in the output

VLAN map for the rewrite operation. “Optional” means the statement may be optionally specified for the rewrite operation in the output VLAN map.

**Table 43: Rewrite Operations and Statement Usage for Output VLAN Maps**

	Output VLAN Map Statements			
Rewrite Operation	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
push	No	Optional	No	No
pop	No	No	No	No
swap	No	Optional	No	No
push-push	No	Optional	No	Optional
swap-push	No	Optional	No	Optional
swap-swap	No	Optional	No	Optional
pop-swap	No	No	No	Optional
pop-pop	No	No	No	No

Input VLAN Map with  
inner-vlan-id  
Statement, Output  
VLAN Map with  
Optional  
inner-tag-protocol-id  
Statement

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop-swap;
  inner-vlan-id number;
}
output-vlan-map {
  pop-swap;
  inner-tag-protocol-id tpid;
}
```

Input VLAN Map with  
inner-tag-protocol-id  
Statement, Output  
VLAN Map with  
Optional  
inner-tag-protocol-id  
Statement

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop-swap;
  inner-tag-protocol-id tpid;
}
output-vlan-map {
  pop-swap;
  inner-tag-protocol-id tpid;
}
```

Input VLAN Map with  
inner-tag-protocol-id  
and inner-vlan-id  
Statements

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop-swap;
  inner-vlan-id number;
  inner-tag-protocol-id tpid;
}
```



- Related Documentation
- [inner-tag-protocol-id on page 995](#)
  - [input-vlan-map on page 1001](#)
  - [output-vlan-map on page 1105](#)
  - [pop-swap on page 1120](#)
  - [unit on page 1228](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Stacking a VLAN Tag

To stack a VLAN tag on all tagged frames entering or exiting the interface, include the **push**, **vlan-id**, and **tag-protocol-id** statements in the input VLAN map or the output VLAN map:

```
input-vlan-map {
    push;
    vlan-id number;
    tag-protocol-id tpid;
}
output-vlan-map {
    push;
    tag-protocol-id tpid;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number*]
- [edit interfaces *interface-name* **unit** *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number*]

If you include the **push** statement in an interface's input VLAN map, see [Table 41 on page 487](#) for information about permissible rewrite operations,

The VLAN IDs you define in the input VLAN maps are stacked on top of the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see “[802.1Q VLANs Overview](#)” on [page 236](#).

All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* **gether-options** **ethernet-switch-profile** **tag-protocol-id** [ *tpids* ]] hierarchy level. For more information, see “[Configuring Inner and Outer TPIDs and VLAN IDs](#)” on [page 490](#).

- Related Documentation
- [tag-protocol-id on page 1200](#)
  - [unit on page 1228](#)

- [Table 41 on page 487](#)
- [802.1Q VLANs Overview on page 236](#)
- [Configuring Inner and Outer TPIDs and VLAN IDs on page 490](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Stacking Two VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, to push two VLAN tags in front of tagged frames entering or exiting the interface, include the **push-push** statement in the input VLAN map or the output VLAN map:

**push-push;**

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

### Related Documentation

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [pop on page 1118](#)
- [unit on page 1228](#)
- See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Removing a VLAN Tag

To remove a VLAN tag from all tagged frames entering or exiting the interface, include the **pop** statement in the input VLAN map or output VLAN map:

**pop;**

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

**Related  
Documentation**

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [pop on page 1118](#)
- [unit on page 1228](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Removing the Outer and Inner VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, to remove both the outer and inner VLAN tags of the frame, include the **pop-pop** statement in the input VLAN map or output VLAN map:

```
pop-pop;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

**Related  
Documentation**

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [pop-pop on page 1119](#)
- [unit on page 1228](#)

- See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, to remove the outer VLAN tag of the frame and replace the inner VLAN tag of the frame with a user-specified VLAN tag value, include the **pop-swap** statement in the input VLAN map or output VLAN map:

**pop-swap;**

The inner tag becomes the outer tag in the final frame.

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

### Related Documentation

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [pop-swap on page 1120](#)
- [unit on page 1228](#)
- See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Rewriting the VLAN Tag on Tagged Frames

To rewrite the VLAN tag on all tagged frames entering the interface to a specified VLAN ID and TPID, include the **swap**, **tag-protocol-id**, and **vlan-id** statements in the input VLAN map:

```
input-vlan-map {
  swap;
  vlan-id number;
  tag-protocol-id tpid;
}
```

To rewrite the VLAN tag on all tagged frames exiting the interface to a specified VLAN ID and TPID, include the **swap** and **tag-protocol-id** statements in the output VLAN map:

```
output-vlan-map {
  swap;
  vlan-id number;
  tag-protocol-id tpid;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* **input-vlan-map**]

You cannot include both the **swap** statement and the **vlan-id** statement in the output VLAN map configuration. If you include the **swap** statement in the configuration, the VLAN ID in outgoing frames is rewritten to the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see “[802.1Q VLANs Overview](#)” on page 236.

The swap operation works on the outer tag only, whether or not you include the **stacked-vlan-tagging** statement in the configuration. For more information, see “[Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags](#)” on page 502.

#### Related Documentation

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [swap on page 1192](#)
- [vlan-id on page 1238](#)
- [tag-protocol-id on page 1200](#)
- [unit on page 1228](#)
- For more information about binding a VLAN ID to the logical interface, see [802.1Q VLANs Overview on page 236](#).
- For more information about the swap operation, see [Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags on page 502](#).
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Rewriting a VLAN Tag on Untagged Frames

- [Overview on page 498](#)
- [Example: push and pop with Ethernet CCC Encapsulation on page 500](#)

- [Example: push-push and pop-pop with Ethernet CCC Encapsulation on page 500](#)
- [Example: push and pop with Ethernet VPLS Encapsulation on page 500](#)
- [Example: push-push and pop-pop with Ethernet VPLS Encapsulation on page 500](#)

## Overview

You can rewrite VLAN tags on untagged incoming and outgoing frames with the `ethernet-ccc` and the `ethernet-vpls` encapsulations for the following routers:

- M120 routers and M320 routers with:
  - Gigabit Ethernet IQ PIC with SFP
  - Gigabit Ethernet IQ2 PICs with SFP
  - Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP
  - 10-Gigabit Ethernet IQ2 PIC with XFP
  - 10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP
- MX240, MX480, and MX960 routers with:
  - Gigabit Ethernet Enhanced DPC with SFP
  - Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP
  - 10-Gigabit Ethernet Enhanced DPCs with XFP
  - 10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP

On M Series routers with Gigabit Ethernet IQ2 PICs and Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs, you can perform all the rewrite VLAN tag operations.

Consider a network where two provider edges (PE) are connected by a Layer 2 circuit. PE1 is receiving traffic on an untagged port while the corresponding port on PE2 is tagged. In the normal case, packets coming from PE1 will be dropped at PE2 because it is expecting tagged packets. However, if PE1 can push a VLAN tag on the incoming packet before sending it across to PE2, you can ensure that packets are not dropped. To make it work in both directions, PE1 must strip the VLAN tag from outgoing packets. Therefore, a push on the ingress side is always paired with a pop on the egress side.

The rewrite operations represented by the following statement options are supported under `ethernet-ccc` and `ethernet-vpls` encapsulations:

- **push**—A VLAN tag is added to the incoming untagged frame.
- **pop**—VLAN tag is removed from the outgoing frame.
- **push-push**—An outer and inner VLAN tag are added to the incoming untagged frame.
- **pop-pop**—Both the outer and inner VLAN tags of the outgoing frame are removed.

IQ2 and 10-Gigabit Ethernet PICs support all rewrite operations described above. Details on the possible combinations of usage are explained later in this section.



**NOTE:** The **push-push** and **pop-pop** operations are not supported on the Gigabit Ethernet IQ PIC.

For the **input-vlan-map** statement, only the **push** and **push-push** options are supported because it does not make sense to remove a VLAN tag from an incoming untagged frame. Similarly, only the **pop** and **pop-pop** options are supported for the **output-vlan-map** statement. Also, with the **push** and **push-push** options, the tag parameters have to be explicitly specified. Apart from this, the other rules for configuring the **input-vlan-map** and **output-vlan-map** statements are the same as for tagged frames. [Table 44 on page 499](#) through [Table 46 on page 499](#) explain the rules in more detail.

For the **input-vlan-map** statement, only the **push** and **push-push** options are supported because it does not make sense to remove a VLAN tag from an incoming untagged frame. Similarly, only the **pop** and **pop-pop** options are supported for the **output-vlan-map** statement. Also, with the **push** and **push-push** options, the **vlan-id** parameters (**vlan-id** for **push** and **vlan-id** or **inner-vlan-id** for **push-push**) have to be explicitly specified. TPID however, is optional and the default value of **0x8100** is set if not configured. Apart from this, the other rules for configuring the **input-vlan-map** and **output-vlan-map** statements are the same as for tagged frames.

**Table 44: Input VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations**

Operation	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
<b>push</b>	Yes	Optional	No	Optional
<b>push-push</b>	Yes	Optional	Yes	Optional

**Table 45: Output VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations**

Operation	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
<b>pop</b>	No	No	No	No
<b>pop-pop</b>	No	No	No	No

**Table 46: Rules for Applying Rewrite Operations to VLAN Maps**

Output VLAN Map			
Input VLAN Map	None	pop	pop-pop
<b>None</b>	Yes	No	No
<b>push</b>	No	Yes	No
<b>push-push</b>	No	No	Yes

You can use the **show interface *interface-name*** command to display the status of a modified VLAN map for the specified interface.

### Example: push and pop with Ethernet CCC Encapsulation

```
ge-3/1/0 {
  encapsulation ethernet-ccc;
  unit 0 {
    encapsulation ethernet-ccc;
    input-vlan-map {
      push;
      tag-protocol-id 0x8100;
      vlan-id 600;
    }
    output-vlan-map pop;
    family ccc;
  }
}
```

### Example: push-push and pop-pop with Ethernet CCC Encapsulation

```
ge-3/1/0 {
  encapsulation ethernet-ccc;
  unit 0 {
    encapsulation ethernet-ccc;
    input-vlan-map {
      push-push;
      tag-protocol-id 0x8100;
      inner-tag-protocol-id 0x8100;
      vlan-id 600;
      inner-vlan-id 575;
    }
    output-vlan-map pop-pop;
    family ccc;
  }
}
```

### Example: push and pop with Ethernet VPLS Encapsulation

```
ge-3/1/0 {
  encapsulation ethernet-vpls;
  unit 0 {
    encapsulation ethernet-vpls;
    input-vlan-map {
      push;
      tag-protocol-id 0x8100;
      vlan-id 700;
    }
    output-vlan-map pop;
    family vpls;
  }
}
```

### Example: push-push and pop-pop with Ethernet VPLS Encapsulation

```
ge-3/1/0 {
```



```

encapsulation ethernet-vpls;
unit 0 {
    encapsulation ethernet-vpls;
    input-vlan-map {
        push-push;
        tag-protocol-id 0x8100;
        inner-tag-protocol-id 0x8100;
        vlan-id 600;
        inner-vlan-id 575;
    }
    output-vlan-map pop-pop;
    family vpls;
}
}

```

#### Related Documentation

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [pop on page 1118](#)
- [pop-pop on page 1119](#)
- [push on page 1139](#)
- [push-push on page 1140](#)
- [unit on page 1228](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Rewriting a VLAN Tag and Adding a New Tag

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and on Gigabit Ethernet and 10-Gigabit Ethernet interfaces on EX Series switches, to replace the outer VLAN tag of the incoming frame with a user-specified VLAN tag value, include the **swap-push** statement in the input VLAN map or output VLAN map:

### swap-push

A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* [unit logical-unit-number](#) [input-vlan-map](#)]
- [edit interfaces *interface-name* [unit logical-unit-number](#) [output-vlan-map](#)]
- [edit logical-systems *logical-system-name* interfaces *interface-name* [unit logical-unit-number](#) [input-vlan-map](#)]
- [edit logical-systems *logical-system-name* interfaces *interface-name* [unit logical-unit-number](#) [output-vlan-map](#)]

See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

**Related  
Documentation**

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [swap-push on page 1193](#)
- [unit on page 1228](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Rewriting the Inner and Outer VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX Series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, to replace both the inner and the outer VLAN tags of the incoming frame with a user-specified VLAN tag value, include the **swap-swap** statement in the input VLAN map or output VLAN map:

**swap-swap;**

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **input-vlan-map**]
- [edit logical-systems *logical-system-name* interfaces *interface-name* **unit** *logical-unit-number* **output-vlan-map**]

See [Table 42 on page 491](#) and [Table 43 on page 492](#) for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

**Related  
Documentation**

- [input-vlan-map on page 1001](#)
- [output-vlan-map on page 1105](#)
- [swap-swap on page 1194](#)
- [unit on page 1228](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags

Configure a VLAN CCC tunnel in which Ethernet frames enter the tunnel at interface **ge-4/0/0** and exit the tunnel at interface **ge-4/2/0**.

The following examples show how to perform the following tasks:

- [Push a TPID and VLAN ID Pair on Ingress on page 503](#)
- [Stack Inner and Outer VLAN Tags on page 504](#)
- [Swap a VLAN ID on Ingress on page 504](#)
- [Swap a VLAN ID on Egress on page 505](#)
- [Swap a VLAN ID on Both Ingress and Egress on page 506](#)
- [Swap the Outer VLAN Tag and Push a New VLAN Tag on Ingress; Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Egress on page 507](#)
- [Swap a TPID and VLAN ID Pair for Both VLAN Tags on Ingress and on Egress on page 507](#)
- [Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Ingress; Swap the Outer VLAN Tag and Push a New VLAN Tag on Egress on page 507](#)
- [Pop a TPID and VLAN ID Pair on Ingress; Push a VLAN ID and TPID Pair on Egress on page 508](#)
- [Pop an Outer VLAN Tag to Connect an Untagged VPLS Interface to Tagged VPLS Interfaces on page 508](#)

#### Push a TPID and VLAN ID Pair on Ingress

```
[edit interfaces]
ge-4/0/0 {
  vlan-tagging;
  encapsulation vlan-ccc;
  gigether-options {
    ethernet-switch-profile {
      tag-protocol-id 0x9909;
    }
  }
  unit 0 {
    encapsulation vlan-ccc;
    vlan-id 512;
    input-vlan-map {
      push;
      tag-protocol-id 0x9909;
      vlan-id 520;
    }
    output-vlan-map pop;
  }
}
ge-4/2/0 {
  vlan-tagging;
  encapsulation vlan-ccc;
  unit 0 {
    encapsulation vlan-ccc;
    vlan-id 515;
    input-vlan-map {
      swap-push;
      vlan-id 520;
      inner-vlan-id 512;
    }
    output-vlan-map {
```

```
        pop-swap;
    }
}
[edit protocols]
mpls {
    interface ge-4/0/0.0;
    interface ge-4/2/0.0;
}
connections {
    interface-switch vlan-tag-push {
        interface ge-4/0/0.0;
        interface ge-4/2/0.0;
    }
}
}
```

**Stack Inner and Outer  
VLAN Tags**

```
[edit interfaces]
ge-0/2/0 {
    stacked-vlan-tagging;
    mac 00.01.02.03.04.05;
    gigether-options {
        loopback;
    }
    unit 0 {
        vlan-tags outer 0x8100.200 inner 0x8100.200;
    }
}
```

**Swap a VLAN ID on  
Ingress**

```
[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id 0x9100;
        }
    }
}
...
unit 1 {
    encapsulation vlan-ccc;
    vlan-id 1000;
    input-vlan-map {
        swap;
        tag-protocol-id 0x9100;
        vlan-id 2000;
    }
}
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
    }
}
```

```

        input-vlan-map {
            swap;
            tag-protocol-id 0x9100;
            vlan-id 1000;
        }
    }
    [edit protocols]
    mpls {
        ...
        interface ge-4/0/0.1;
        interface ge-4/2/0.1;
    }
    connections {
        ...
        interface-switch vlan-tag-swap {
            interface ge-4/2/0.1;
            interface ge-4/0/0.1;
        }
    }
}

```

#### Swap a VLAN ID on Egress

```

[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 1000;
    }
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id 0x8800;
        }
    }
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        output-vlan-map {
            swap;
            tag-protocol-id 0x8800;
        }
    }
}
[edit protocols]
mpls {
    ...
    interface ge-4/0/0.1;
    interface ge-4/2/0.1;
}
connections {

```

**Swap a VLAN ID on  
Both Ingress and  
Egress**

```

...
interface-switch vlan-tag-swap {
    interface ge-4/2/0.1;
    interface ge-4/0/0.1;
}
}

[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id [ 0x8800 0x9100 ];
        }
    }
}
...
unit 1 {
    encapsulation vlan-ccc;
    vlan-id 1000;
    input-vlan-map {
        swap;
        tag-protocol-id 0x9100;
        vlan-id 2000;
    }
}
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id [ 0x8800 0x9100 ];
        }
    }
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        output-vlan-map {
            swap;
            tag-protocol-id 0x8800;
        }
    }
}
}
[edit protocols]
mpls {
    ...
    interface ge-4/0/0.1;
    interface ge-4/2/0.1;
}
connections {
    ...
    interface-switch vlan-tag-swap {
        interface ge-4/2/0.1;
        interface ge-4/0/0.1;
    }
}

```

	}
<b>Swap the Outer VLAN Tag and Push a New VLAN Tag on Ingress; Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Egress</b>	<pre> [edit interfaces] ge-1/1/0 {   unit 1 {     vlan-id 200;     input-vlan-map {       swap-push;       tag-protocol-id 0x9100;       vlan-id 400;       inner-tag-protocol-id 0x9100;       inner-vlan-id 500;     }     output-vlan-map {       pop-swap;       inner-tag-protocol-id 0x9100;     }   } } </pre>
<b>Swap a TPID and VLAN ID Pair for Both VLAN Tags on Ingress and on Egress</b>	<pre> [edit interfaces] ge-1/1/0 {   unit 0 {     vlan-tags {       inner 0x9100.425;       outer 0x9200.525;     }     input-vlan-map {       swap-swap;       tag-protocol-id 0x9100;       vlan-id 400;       inner-tag-protocol-id 0x9100;       inner-vlan-id 500;     }     output-vlan-map {       swap-swap;       tag-protocol-id 0x9200;       inner-tag-protocol-id 0x9100;     }   } } </pre>
<b>Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Ingress; Swap the Outer VLAN Tag and Push a New VLAN Tag on Egress</b>	<pre> [edit interfaces] ge-1/1/0 {   unit 0 {     vlan-tags {       inner 0x9100.425;       outer 0x9200.525;     }     input-vlan-map {       pop-swap;       tag-protocol-id 0x9100;       vlan-id 400;     }     output-vlan-map{ </pre>

	<pre>        swap-push;         tag-protocol-id 0x9200;         inner-tag-protocol-id 0x9100;     } } }</pre>
Pop a TPID and VLAN ID Pair on Ingress; Push a VLAN ID and TPID Pair on Egress	<pre>[edit interfaces] ge-1/1/0 {   unit 0 {     vlan-tags {       inner 0x9100.425;       outer 0x9200.525;     }     input-vlan-map {       pop-pop;     }     output-vlan-map {       push-push;       tag-protocol-id 0x9200;       inner-tag-protocol-id 0x9100;     }   } }</pre>
Pop an Outer VLAN Tag to Connect an Untagged VPLS Interface to Tagged VPLS Interfaces	<pre>[edit interfaces] ge-1/1/0 {   vlan-tagging;   encapsulation extended-vlan-vpls;   unit 0 {     vlan-id 0;     input-vlan-map {       push;       vlan-id 0;     }     output-vlan-map pop;     family vpls;   } }</pre>

Related Documentation	<ul style="list-style-type: none"><li>• <a href="#">input-vlan-map on page 1001</a></li><li>• <a href="#">output-vlan-map on page 1105</a></li><li>• <a href="#">inner-tag-protocol-id on page 995</a></li><li>• <a href="#">inner-vlan-id on page 996</a></li><li>• <a href="#">pop on page 1118</a></li><li>• <a href="#">pop-pop on page 1119</a></li><li>• <a href="#">pop-swap on page 1120</a></li><li>• <a href="#">push on page 1139</a></li><li>• <a href="#">push-push on page 1140</a></li></ul>
-----------------------	---



- [swap on page 1192](#)
- [swap-push on page 1193](#)
- [swap-swap on page 1194](#)
- [unit on page 1228](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Understanding Transparent Tag Operations and IEEE 802.1p Inheritance

When **swap-by-poppush** is configured on IQ2 interfaces, 10-Gigabit Ethernet LAN/WAN PIC, IQ2-E interfaces, and MX Series interfaces, during a swap operation, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the tag being swapped. If swap-by-poppush is not configured on the interface, the VLAN IEEE 802.1p bits of the tag being swapped remains same.

When **swap-by-poppush** is configured but the incoming packet has no inner VLAN tag (transparent tag), the IEEE 802.1p bits are set to zero .

[Table 47 on page 509](#) describes the relationship between the VLAN map operation and the inheritance of IEEE 802.1p from the transparent tag. It assumes the presence of the transparent tag in the incoming packet. If the transparent tag is not present, the IEEE 802.1p value is set to 0.

**Table 47: VLAN Map Operation and IEEE 802.1p Inheritance**

Rewrite Operation	Untagged Logical Interface	Transparent tag IEEE 802.1p Inheritance	Single-tagged Logical Interface	Transparent tag IEEE 802.1p Inheritance	Change in number of tags
push-push	yes	OUTER, INNER	NA	no operation	+2
swap-push	NA	no operation	yes	OUTER, INNER	+1
push	yes	OUTER	yes	*none	+1
swap	NA	NA	yes	OUTER	0

**NOTE:** \*In a **push** operation on a single-tagged logical interface, none of the tags (inner, or outer) inherit the IEEE 802.1p bits from the transparent tag.

The following section shows four different examples of the inheritance of the transparent IEEE 802.1p values into the outer and inner VLAN tags.

[Figure 28 on page 510](#) shows an incoming packet with a transparent tag. A swap-push operation swaps the outer VLAN tag and pushes another VLAN tag. The IEEE 802.1p values are inherited from the transparent tag.

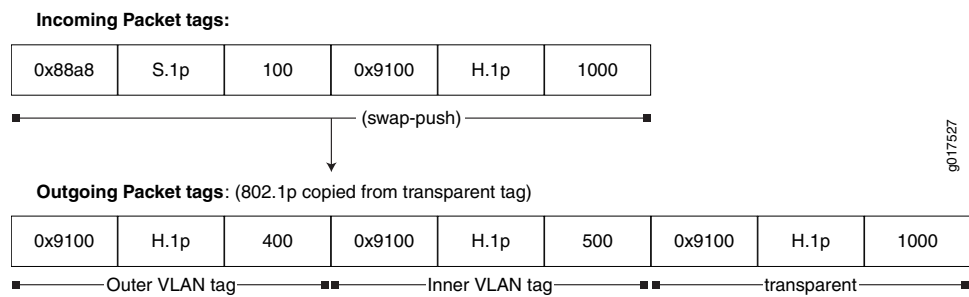
**Figure 28: swap-push (transparent tag)**

Figure 29 on page 510 shows an incoming packet with no transparent tag. A swap-push operation swaps the outer VLAN tag and pushes another VLAN tag. The IEEE 802.1p value is set to zero, as there is no transparent tag.

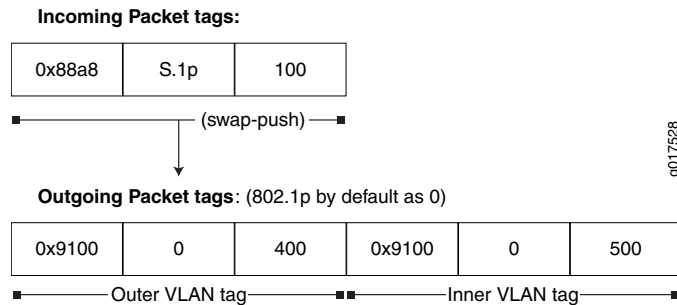
**Figure 29: swap-push (no transparent tag)**

Figure 30 on page 510 shows an incoming packet with a transparent tag. A push operation pushes another VLAN tag. The IEEE 802.1p value is inherited from the transparent tag.

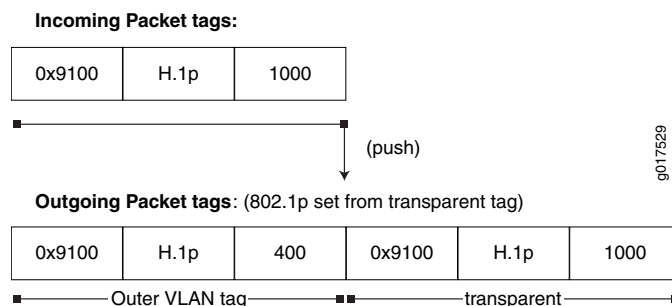
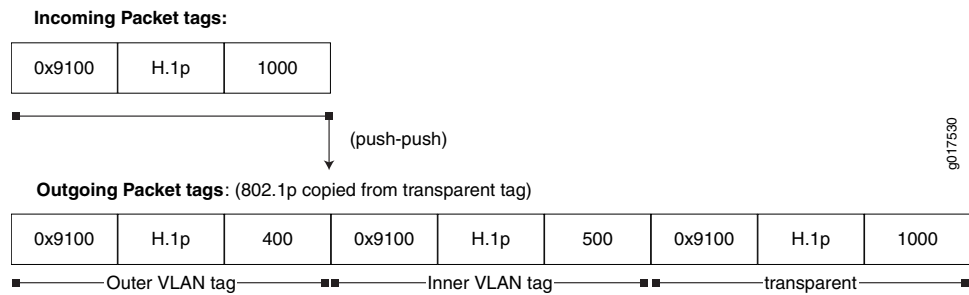
**Figure 30: push (transparent tag)**

Figure 31 on page 511 shows an incoming packet with a transparent tag. A push-push operation pushes the outer and inner VLAN tags, respectively. The IEEE 802.1p values are inherited from the transparent tag.

Figure 31: push-push (transparent tag)

**Related Documentation**

- [Understanding IEEE 802.1p Inheritance push and swap from a Transparent Tag](#)
- [Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag on page 511](#)
- [Understanding swap-by-poppush on page 511](#)
- [swap-by-poppush on page 1192](#)
- *transparent*

## Understanding swap-by-poppush

By default, during a swap operation, the IEEE 802.1p bits of the VLAN tag remain unchanged. When the **swap-by-poppush** operation is enabled on a logical interface, the swap operation is treated as a **pop** operation followed by **push** operation. The **pop** operation removes the existing tag and the associated IEEE 802.1p bits and the push operation copies the inner VLAN IEEE 802.1p bits to the IEEE bits of the VLAN or VLANs being pushed. As a result, the IEEE 802.1p bits are inherited from the incoming transparent tag.

In effect, **swap-by-poppush** serves as a VLAN operation property and is used along with a **swap** or **swap-push** VLAN rewrite operation, indicating the nature of the swap operation being performed.

**Related Documentation**

- [swap-by-poppush on page 1192](#)
- *transparent*
- [Understanding IEEE 802.1p Inheritance push and swap from a Transparent Tag](#)
- [Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag on page 511](#)
- [Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 509](#)

## Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag

To classify incoming packets based on the IEEE 802.1p bits from the transparent tag, include the **transparent** statement at the `[edit class-of-service interfaces interface-name unit logical-unit-number classifiers ieee-802.1p vlan-tag]` hierarchy level.

**Tagged Interface Example** The following example configuration specifies the classification based on the transparent VLAN tag.

```
edit
class-of-service {
  interfaces {
    ge-3/0/1 {
      unit 0 {
        classifiers {
          ieee-802.1 default vlan-tag transparent;
        }
      }
    }
  }
}
```

To configure Junos OS to inherit the IEEE 802.1p bits from the transparent tag, include the **swap-by-poppush** statement at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level.

The following is a configuration to swap and push VLAN tags and allow inheritance of the IEEE 802.1p value from the transparent VLAN tag in incoming packets.

```
edit
ge-3/0/0 {
  vlan-tagging;
  encapsulation vlan-ccc;
  unit 0 {
    encapsulation vlan-ccc;
    vlan-id 100;
    swap-by-poppush;
    input-vlan-map {
      swap-push;
      tag-protocol-id 0x9100;
      inner-tag-protocol-id 0x9100;
      vlan-id 500;
      inner-vlan-id 400;
    }
    output-vlan-map {
      pop-swap;
      inner-vlan-id 100;
      inner-tag-protocol-id 0x88a8;
    }
  }
}
```

The **swap-by-poppush** statement causes a swap operation to be done as a pop followed by a push operation. So for the outer tag, the incoming S-Tag is popped and a new tag is pushed. As a result, the S-Tag inherits the IEEE 802.1p bits from the transparent tag. The inner tag is then pushed, which results in the inner tag inheriting the IEEE 802.1p bits from the transparent tag.

**Untagged Interface Example** The following is a configuration to push two VLAN tags and allow inheritance of the IEEE 802.1p value from the transparent VLAN tag in the incoming packet.

```
[edit]
```

```

ge-3/0/1 {
  encapsulation ccc;
  unit 0 {
    input-vlan-map {
      push-push;
      tag-protocol-id 0x9100;
      inner-tag-protocol-id 0x9100;
      vlan-id 500;
      inner-vlan-id 400;
    }
    output-vlan-map {
      pop-pop;
    }
  }
}

```

No additional configuration is required to inherit the IEEE 802.1p value, as the **push** operation inherits the IEEE 802.1p values by default.

The following configuration specifies the classification based on the transparent VLAN tag.

```

[edit]
class-of-service {
  interfaces {
    ge-3/0/1 {
      unit 0 {
        classifiers {
          ieee-802.1 default vlan-tag transparent;
        }
      }
    }
  }
}

```

#### Related Documentation

- *transparent*
- [swap-by-poppush on page 1192](#)
- *Understanding IEEE 802.1p Inheritance push and swap from a Transparent Tag*
- [Understanding swap-by-poppush on page 511](#)
- [Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 509](#)



## PART 3

# Operation, Administration, and Management (OAM) for Ethernet Interfaces

- [Configuring IEEE 802.1ag OAM Connectivity-Fault Management on page 517](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 593](#)
- [Configuring ITU-T Y.1731 Ethernet Service OAM on page 621](#)
- [Configuring Ethernet Ring Protection on page 737](#)





## CHAPTER 31

# Configuring IEEE 802.1ag OAM Connectivity-Fault Management

- Ethernet Operations, Administration, and Maintenance on page 518
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519
- Continuity Check Protocol Parameters Overview on page 523
- Creating a Maintenance Domain on page 525
- Configuring Maintenance Intermediate Points (MIPs) on page 526
- Creating a Maintenance Association on page 528
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 529
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530
- Configuring Service Protection for VPWS over MPLS Using the MEP Interface on page 534
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538
- Configuring Linktrace Protocol in CFM on page 539
- Configuring Ethernet Local Management Interface on page 540
- Configuring Port Status TLV and Interface Status TLV on page 548
- Configuring MAC Flush Message Processing in CET Mode on page 560
- Example: Configuring an Action Profile Based on Connection Protection TLVs on page 563
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565
- Configuring Rate Limiting of Ethernet OAM Messages on page 566
- Configuring Unified ISSU for 802.1ag CFM on page 569
- Configuring Continuity Check Messages for Better Scalability on page 572
- Configuring Faster Protection Switching for Point-to-Point Network Topologies on page 573
- Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies on page 575
- Configuring a Primary VLAN ID for Increased Flexibility on page 576
- Configuring a Remote Maintenance Association to Accept a Different ID on page 577
- Example: Configuring Ethernet CFM on Physical Interfaces on page 577

- [Example: Configuring Ethernet CFM on Bridge Connections on page 580](#)
- [Example: Configuring Ethernet CFM over VPLS on page 583](#)

---

## Ethernet Operations, Administration, and Maintenance

---

This topic provides an overview to help you effectively configure Ethernet Operations, Administration, and Maintenance (OAM) on a network of Juniper Networks® MX Series 3D Universal Edge Routers. For more information about configuring OAM parameters on Ethernet interfaces, see the *Junos OS Network Interfaces Library for Routing Devices*.

Ethernet OAM provides the tools that network management software and network managers can use to determine how a network of Ethernet links is functioning. Ethernet OAM should:

- Rely only on the media access control (MAC) address or virtual local area network (VLAN) identifier for troubleshooting.
- Work independently of the actual Ethernet transport and function over physical Ethernet ports, or a virtual service such as pseudowire, and so on.
- Isolate faults over a flat (or single operator) network architecture or a nested or hierarchical (or multi-provider) network.

OAM can provide simple link-level information, provide performance statistics, or track end-to-end connectivity across the network. Simple link fault management (LFM) for Ethernet links is defined in IEEE 802.3ah.

IEEE 802.1ag OAM is supported on untagged, single tagged, and stacked VLAN interfaces.

Ethernet OAM functions are implemented as:

- Fault detection and notification (provided by continuity check messages)
- Path discovery (provided by the linktrace protocol)
- Fault isolation, verification, and recovery (isolation and verification are provided by a combination of protocols, while recovery is the function of protocols such as spanning tree)

The loopback protocol used in Ethernet OAM is modeled on the standard IP ping. After a fault is detected, the loopback protocol performs fault verification and isolation under the direction of a network operator.

The loopback is performed using request and response message pairs. A unicast loopback message is generated by a maintenance endpoint (MEP), and a loopback reply is generated by the destination maintenance intermediate point (MIP) or MEP.

The target MAC address is learned by the continuity check protocol or linktrace protocol. The loopback message's packet is always forwarded to a unique port by the originating MEP, as determined by a MAC table lookup or the MEP interface MAC address.

The target MIP or MEP generates a unicast loopback reply in response to the received loopback message. The loopback message follows the same path as a data packet, and intermediate bridges simply forward the packet to the destination MIP or MEP.

- Related Documentation**
- [Ethernet OAM Connectivity Fault Management](#)
  - [Example: Configuring Ethernet CFM on Bridge Connections](#)
  - [Example: Configuring Ethernet CFM on Physical Interfaces](#)

---

## IEEE 802.1ag OAM Connectivity Fault Management Overview

Ethernet interfaces on M7i and M10i routers with the Enhanced CFEB (CFEB-E) and on M120, M320, MX Series, T Series, and PTX Series routers support the IEEE 802.1ag standard for Operation, Administration, and Management (OAM). The IEEE 802.1ag specification provides for Ethernet connectivity fault management (CFM). The goal of CFM is to monitor an Ethernet network that may comprise one or more service instances. Junos OS supports IEEE 802.1ag connectivity fault management.

In Junos OS Release 9.3 and later, CFM also supports aggregated Ethernet interfaces. Connectivity fault management (CFM) sessions operate in distributed mode and are processed on the Flexible PIC Concentrator (FPC) on aggregated Ethernet interfaces. As a result, graceful Routing Engine switchover (GRES) is supported on aggregated Ethernet interfaces. In releases before Junos OS Release 13.3, CFM sessions operate in centralized mode and are processed on the Routing Engine. However, CFM sessions are not supported on aggregated Ethernet interfaces if the interfaces that form the aggregated Ethernet bundle are in mixed mode. CFM sessions with a continuity check message (CCM) interval of 10 milliseconds are not supported over aggregated Ethernet interfaces.

CFM sessions are distributed by default. All CFM sessions must operate in either only distributed or only centralized mode. A mixed operation of distributed and centralized modes for CFM sessions is not supported. To disable the distribution of CFM sessions on aggregated Ethernet interfaces and make the sessions operate in centralized mode, include the **no-aggregate-delegate-processing** statement at the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level.

**NOTE:**

- CFM sessions are supported on aggregated Ethernet interfaces if the interfaces that form the aggregated Ethernet bundle are in mixed mode when the `no-aggregate-delegate-processing` command is enabled.
- For CFM sessions in centralized mode, we recommend that you configure a maximum of 40 CFM sessions with continuity check message (CCM) interval of 100 milliseconds (100 ms) or a maximum of 400 CFM sessions with CCM interval of 1 second (1 s). If CFM sessions are configured beyond this limit, CFM might not work as expected. You might observe issues when the state of multiple links change or when the line cards are restarted.

Note that these limits have been derived by considering a protocol data unit (PDU) load of 400 packets per second (pps) on the Routing Engine. This limit varies depending on the Routing Engine load. If the Routing Engine experiences heavy load, expect some variations to this limit.

On interfaces configured on Modular Port Concentrators (MPCs) and Modular Interface Cards (MICs) on MX Series routers, CFM is not supported on untagged aggregated Ethernet member links. MPCs and MICs do support CFM on untagged and tagged aggregated Ethernet logical interfaces. CFM does not support Multichassis Link Aggregation (MC-LAG). Do not configure the `mc-ae` statement when you configure CFM.

On T Series and M320 routers, CFM is not supported on interfaces configured with CCC encapsulation. If you configure CFM, the system displays the following message: **“MEPs cannot be configured on ccc interface on this platform”**.

Network entities such as operators, providers, and customers may be part of different administrative domains. Each administrative domain is mapped into one maintenance domain. Maintenance domains are configured with different level values to keep them separate. Each domain provides enough information for the entities to perform their own management, perform end-to-end monitoring, and still avoid security breaches.



**NOTE:** As a requirement for Ethernet OAM 802.1ag to work, distributed periodic packet management (PPM) runs on the Routing Engine and Packet Forwarding Engine. You can only disable PPM on the Packet Forwarding Engine. To disable PPM on the PFE, include the `ppm no-delegate-processing` statement at the `[edit routing-options ppm]` hierarchy level.

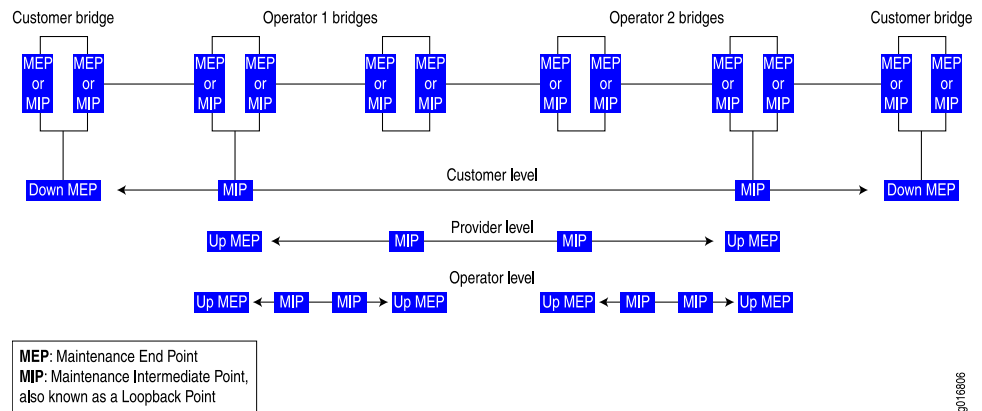
IEEE 802.1ag OAM supports graceful Routing Engine switchover (GRES). IEEE 802.1ag OAM is supported on untagged, single tagged, and stacked VLAN interfaces.

- [Connectivity Fault Management Key Elements on page 521](#)
- [Best Practices for Configuring 802.1ag Ethernet OAM for VPLS on page 522](#)

## Connectivity Fault Management Key Elements

Figure 32 on page 521 shows the relationships among the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

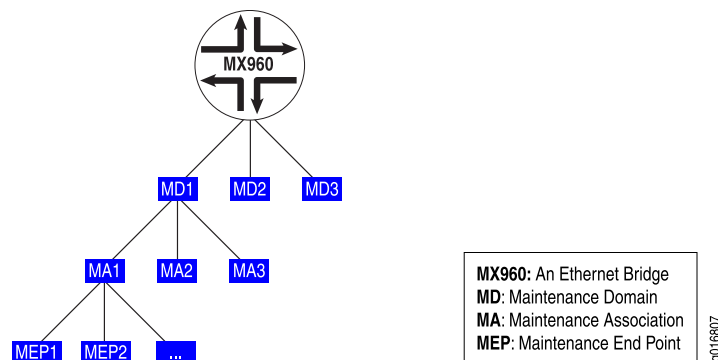
**Figure 32: Relationship Among MEPs, MIPs, and Maintenance Domain Levels**



**NOTE:** Maintenance intermediate points (MIP) are not supported on the ACX Series routers.

A maintenance association is a set of MEPs configured with the same maintenance association identifier and maintenance domain level. Figure 33 on page 521 shows the hierarchical relationships between the Ethernet bridge, maintenance domains, maintenance associations, and MEPs.

**Figure 33: Relationship Among Bridges, Maintenance Domains, Maintenance Associations, and MEPs**



## Best Practices for Configuring 802.1ag Ethernet OAM for VPLS

---



**BEST PRACTICE:** The logical interfaces in a VPLS routing instance may have the same or different VLAN configurations. VLAN normalization is required to switch packets correctly among these interfaces. VLAN normalization is effectively VLAN translation wherein the VLAN tags of the received packet need to be translated if they are different than the normalized VLAN tags. Configuration is described starting in “[IEEE 802.1ag OAM Connectivity Fault Management Overview](#)” on [page 519](#) and you should further observe the additional requirements described in this section.

For MX Series routers, the normalized VLAN is specified using one of the following configuration statements in the VPLS routing instance:

- `vlan-id vlan-number`
- `vlan-id none`
- `vlan-tags outer outer-vlan-number inner inner-vlan-number`

You must configure `vlan-maps` explicitly on all interfaces belonging to the routing instance.

The following forwarding path considerations must be observed:

- Packet receive path:
  - This is the forwarding path for packets received on the interfaces.
  - 802.1ag Ethernet OAM for VPLS uses implicit interface filters and forwarding table filters to flood, accept, and drop the CFM packets.
- Packet transmit path:
  - The JUNOS Software uses the router's hardware-based forwarding for CPU-generated packets.
  - For Down MEPs, the packets are transmitted on the interface on which the MEP is configured.
  - In MX series routers, for Up MEPs, the packet must be flooded to other interfaces in the VPLS routing instance. The router creates a flood route tied to a flood next hop (with all interfaces to flood) and then sources the packet to be forwarded with this flood route.
  - The router also uses implicit-based forwarding for CPU generated packets. The result is for the flood next hop tied to the flood route to be tied to the filter term. The filter term uses match criteria to correctly identify the host-generated packets.

---

Related Documentation • [connectivity-fault-management on page 914](#)

- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Continuity Check Protocol Parameters Overview

The continuity check protocol is used for fault detection by maintenance end points (MEPs) within a maintenance association. The MEP periodically sends continuity check multicast messages. The continuity check protocol packets use the ethertype value 0x8902 and the multicast destination MAC address 01:80:c2:00:00:32.

The following list describes the continuity check protocol parameters you can configure:

- **interval**—Frequency of the continuity check messages (CCM) i.e time between the transmission of the CCM messages. You can specify 10 minutes (**10m**), 1 minute (**1m**), 10 seconds (**10s**), 1 second (**1s**), 100 milliseconds (**100ms**), or 10 milliseconds (**10ms**). The default value is 1 minute. For instance, if you specify the interval as 1 minute, the MEP sends the continuity check messages every minute to the receiving MEP.



**NOTE:** For the continuity check message interval to be configured for 10 milliseconds, periodic packet management (PPM) runs on the Routing Engine and Packet Forwarding Engine (PFE) by default. You can only disable PPM on the PFE. To disable PPM on the PFE, use the `no-delegate-processing` statement at the `[edit routing-options ppm]` hierarchy level.

Continuity check interval of 10 milliseconds is not supported for CFM sessions over a Label-Switched interface (LSI).

- **hold-interval**—Frequency at which the MEP database can be flushed, if no updates occur. Receiving MEPs use the continuity check messages to build a MEP database of all MEPs in the maintenance association. You can configure the frequency at which the MEP database can be flushed, if no updates occur. The frequency is the number

of minutes to wait before flushing the MEP database if no updates occur. The default value is 10 minutes.



**NOTE:** Hold timer based flushing is applicable only for auto discovered remote MEPs and not for statically configured remote MEPs.

The hold interval logic runs a polling timer per CFM session level (not per remote MEP level) where the polling timer duration is equal to the configured hold time. When the polling timer expires, it deletes all the auto discovered remote MEP entries which have been in the failed state for a time period equal to or greater than the configured hold time. If the remote MEP completes the hold time duration in the failed state, then flushing will not occur until the next polling timer expires. Hence remote MEP flushing may not happen exactly at the configured hold time.

- **loss-threshold**—Number of continuity check messages that can be lost before the router marks the MEP as down. The value can be from 3 to 256 protocol data units (PDUs). The default value is 3 PDUs.

**Related  
Documentation**

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [Managing Continuity Measurement Statistics on page 691](#)
- [\*Ethernet Interfaces Feature Guide for Routing Devices\*](#)



## Creating a Maintenance Domain

To enable connectivity fault management (CFM) on an Ethernet interface, you must first configure a maintenance domain and specify the name of the maintenance domain. You can also specify the format of the name. For instance, if you specify the name format to be domain name service (DNS) format, you can specify the name of the maintenance domain as `www.juniper.net`. The default name format is ASCII character string.



**NOTE:** For logical interfaces, the maintenance domain name must be unique across logical systems. If you configure the same maintenance domain name across logical systems, then you receive the following error message: `error: configuration check-out failed`.

During the creation of the maintenance domain, you can also specify the maintenance domain level. The maintenance domain level indicates the nesting relationship between various maintenance domains. The maintenance domain level is embedded in each of the CFM frames.

To create a maintenance domain:

1. In configuration mode, create a maintenance domain by specifying the name and the name format at the `[edit protocols oam ethernet connectivity-fault-management]` hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set maintenance-domain md-name name-format option
```



**NOTE:** If you configure the maintenance domain name length greater than 45 octet, then the following error message is displayed: `error: configuration check-out failed`.

2. Specify the maintenance domain level by specifying the value at the `[edit protocols oam ethernet connectivity-fault-management]` hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set maintenance-domain md-name level number
```

### Related Documentation

- [connectivity-fault-management on page 914](#)
- [maintenance-domain on page 1053](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)

- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [name-format on page 1076](#)
- [level on page 1021](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Maintenance Intermediate Points (MIPs)

MX Series routers support maintenance intermediate points (MIPs) for the Ethernet OAM 802.1ag CFM protocol at a bridge-domain level. This enables you to define a maintenance domain for each default level. The MIPs names are created as **default-level-number** at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain]** hierarchy level. Use the **bridge-domain**, **instance**, **virtual-switch**, and **mip-half-function** MIP options to specify the MIP configuration.

Use the **show oam ethernet connectivity-fault-management mip (bridge-domain | instance-name | interface-name)** command to display the MIP configurations.

To configure the maintenance intermediate point (MIP):

1. Configure a bridge domain under a user-defined virtual switch by specifying the **virtual-switch** statement and the name of the user-defined virtual switch, at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name default-x]** hierarchy level.



**NOTE:** A bridge domain must be specified by name only if it is configured by including the **vlan-id** statement under the **virtual-switch** statement. If a bridge domain is configured with a range of VLAN IDs, then the VLAN IDs must be explicitly listed after the bridge domain name.

---

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
 domain-name default-x]
user@host# set virtual-switch virtual-switch-name bridge-domain bridge-domain-name
vlan-id value
```



**NOTE:** You can also configure the bridge domain for the default virtual switch by including the `bridge-domain` statement at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name]` hierarchy level.

2. Configure the VPLS routing instance for the default maintenance domain.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name]
user@host# set instance instance-name
```

3. Configure the maintenance intermediate point (MIP) half function to divide the MIP functionality into two unidirectional segments to improve network coverage by increasing the number of MIPs that are monitored. The MIP half function also responds to loop-back and link-trace messages to identify faults.



**NOTE:** Whenever a MIP is configured and a bridge domain is mapped to multiple maintenance domains or maintenance associations, it is essential that the `mip-half-function` value for all maintenance domains and maintenance associations be the same.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name default-x]
user@host# set mip-half-function (none | default | explicit)
```

#### Related Documentation

- [bridge-domain on page 891](#)
- [connectivity-fault-management on page 914](#)
- [instance on page 1002](#)
- [mip-half-function on page 1066](#)
- [virtual-switch on page 1236](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)

- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Creating a Maintenance Association

To create a maintenance association, include the **maintenance-association *ma-name*** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*]** hierarchy level.

Maintenance association names can be in one of the following formats:

- As a plain ASCII character string
- As the VLAN identifier of the VLAN you primarily associate with the maintenance association
- As a two-octet identifier in the range from 0 through 65,535
- As a name in the format specified by RFC 2685

The default short name format is an ASCII character string.

To configure the maintenance association short name format, include the **short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id)** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]** hierarchy level.

### Related Documentation

- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Continuity Check Protocol Parameters for Fault Detection

The continuity check protocol is used for fault detection by a MEP within a maintenance association. A MEP periodically generates and responds to continuity check multicast messages. The continuity check protocol packets use the ethertype value 0x8902 and the multicast destination MAC address 01:80:c2:00:00:32. The receiving MEPs use the continuity check messages to build a MEP database of all MEPs in the maintenance association.

To configure continuity check protocol parameters:

1. In configuration mode, at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name continuity-check]` hierarchy level, specify the time to wait in minutes before flushing the maintenance association end point (MEP) database, if no updates occur, with a value from 1 minute through 30240 minutes. The default value is 10 minutes.



**NOTE:** Hold timer based flushing is applicable only for auto discovered remote MEPs and not for statically configured remote MEPs.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name continuity-check]
user@host# set hold-interval minutes
```

2. Specify the time to wait between the transmissions of continuity check messages. The duration can be one of the following values: 10 minutes(10m), 1 minute(1m), 10 seconds(10s), 1 second(1s), 100 milliseconds(100ms), or 10 milliseconds(10ms). The default value is 1 minute.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name continuity-check]
user@host# set interval option
```

3. Specify the number of continuity check messages that can be lost before the router marks the MEP down. The value can be from 3 to 256 protocol data units (PDUs). The default value is 3 PDUs.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name continuity-check]
user@host# set loss-threshold number
```

### Related Documentation

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Continuity Check Protocol Parameters Overview on page 523](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)

- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [Managing Continuity Measurement Statistics on page 691](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring a MEP to Generate and Respond to CFM Protocol Messages

A maintenance association end point (MEP) refers to the boundary of a domain. A MEP generates and responds to connectivity fault management (CFM) protocol messages. You can configure only one up MEP for every unique combination of maintenance association name and maintenance domain identifier. You can configure multiple down MEPs for a single instance of maintenance domain identifier and maintenance association name to monitor services provided by Virtual Private LAN service (VPLS), bridge domain, circuit cross-connect (CCC), or IPv4 domains.

You can enable automatic discovery of a MEP. With automatic discovery a MEP is enabled to accept continuity check messages (CCMs) from all remote MEPs of the same maintenance association. If automatic discovery is not enabled, the remote MEPs must be configured. If the remote MEP is not configured, the CCMs from the remote MEP are treated as errors.

Continuity measurement is provided by an existing continuity check protocol. The continuity for every remote MEP is measured as the percentage of time that remote MEP was operationally up over the total administratively enabled time. Here, the operational uptime is the total time during which the CCM adjacency is active for a particular remote MEP and the administrative enabled time is the total time during which the local MEP is active. You can also restart the continuity measurement by clearing the currently measured operational uptime and the administrative enabled time.

- [Configuring a Maintenance Association End Point \(MEP\) on page 530](#)
- [Configuring a remote Maintenance Association End Point \(MEP\) on page 532](#)

## Configuring a Maintenance Association End Point (MEP)

To configure a maintenance association end point:

1. Specify an ID for the MEP at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]**. You can specify any value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name]
user@host# set mep mep-id
```

2. Enable maintenance end point automatic discovery so the MEP can accept continuity check messages (CCMs) from all remote MEPs of the same maintenance association.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set auto-discovery
```

3. Specify the direction in which the CCM packets are transmitted for the MEP. You can specify up or down. If you specify the direction as up, CCMs are transmitted out of every logical interface that is part of the same bridging or VPLS instance except for the interface configured on the MEP. If you specify the direction as down, CCMs are transmitted only out of the interface configured on the MEP.



**NOTE:** Ports in the Spanning Tree Protocol (STP) blocking state do not block CFM packets destined to a down MEP. Ports in an STP blocking state without the continuity check protocol configured do block CFM packets.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set direction down
```



**NOTE:** Starting with Junos OS Release 12.3, for all interfaces configured on Modular Port Concentrators (MPCs) on MX Series 3D Universal Edge Routers, you no longer need to configure the `no-control-word` statement for all Layer 2 VPNs and Layer 2 circuits over which you are running CFM MEPs. For all other interfaces on MX Series routers and on all other routers and switches, you must continue to configure the `no-control-word` statement at the `[edit routing-instances routing-instance-name protocols l2vpn]` or `[edit protocols l2circuit neighbor neighbor-id interface interface-name]` hierarchy level when you configure CFM MEPs. Otherwise, the CFM packets are not transmitted, and the `show oam ethernet connectivity-fault-management mep-database` command does not display any remote MEPs.

4. Specify the interface to which the MEP is attached. It can be a physical interface, logical interface, or trunk interface. On MX Series routers, the MEP can be attached to a specific VLAN of a trunk interface.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set interface interface-name
```

5. Specify the IEEE 802.1 priority bits that are used by continuity check and link trace messages. You can specify a value from through 7 as the priority.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set priority number
```

- Specify the lowest priority defect that generates a fault alarm whenever CFM detects a defect. Possible values include: all-defects, err-xcon, mac-rem-err-xcon, no-defect, rem-err-xcon, and xcon.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set lowest-priority-defect mac-rem-err-xcon
```

- Specify the ID of the remote MEP at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id]**. You can specify any value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set remote-mep mep-id
```

## Configuring a remote Maintenance Association End Point (MEP)

To configure a remote maintenance association end point:

- Configure the remote MEP by specifying the MEP ID at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id]**. You can specify any value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# edit remote-mep mep-id
```

- Specify the name of the action profile to be used for the remote MEP by including the **action-profile profile-name** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id]**. The profile must be defined at the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id remote-mep
  remote-mep-id]
user@host# set action-profile profile-name
```

- Configure the remote MEP to detect initial loss of connectivity. By default, the MEP does not generate loss-of-continuity (LOC) defect messages. When you configure the **detect-loc** statement, a loss-of-continuity (LOC) defect is detected if no continuity check message is received from the remote MEP within a period equal to 3.5 times the continuity check interval configured for the maintenance association. If a LOC defect is detected, a syslog error message is generated.





**NOTE:** When you configure connectivity-fault management (CFM) along with detect-loc, any action-profile configured to bring down the interface is executed if continuity check message is not received. However, the action-profile is not executed if you have not configured detect-loc and continuity check message is not received.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id remote-mep
  remote-mep-id]
user@host# set detect-loc
```

#### Related Documentation

- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Configuring Service Protection for VPWS over MPLS Using the MEP Interface on page 534](#)

## Configuring Service Protection for VPWS over MPLS Using the MEP Interface

You can enable service protection for a virtual private wire service (VPWS) over MPLS by specifying a working path or protect path on the MEP. Service protection provides end-to-end connection protection of the working path in the event of a failure.

To configure service protection, you must create two separate transport paths—a working path and a protect path. You can specify the working path and protect path by creating two maintenance associations. To associate the maintenance association with a path, you must configure the **interface** statement for the MEP within the maintenance association and specify the path as working or protect.



**NOTE:** If the path is not specified, the session monitors the active path.

Table 48 on page 534 describes the available service protection options.

**Table 48: Service Protection Options**

Option	Description
<b>working</b>	Specifies the working path.
<b>protect</b>	Specifies the protect path.

In this configuration, we enable service protection for the VPWS service. The CCM session is configured for the working path and references the CCM session configured for the protect path using the **protect-maintenance-association** statement. The name of the protect transport path for the maintenance association is configured and associated with the maintenance association for the working path.

To configure service protection for VPWS over MPLS:

1. In configuration mode, create a maintenance domain by specifying the name and the name format at the **[edit protocols oam ethernet connectivity-fault-management ]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set maintenance-domain md-name name-format option
```



**NOTE:** If you configure the maintenance domain name length greater than 45 octet, then the following error message is displayed: **error: configuration check-out failed.**

2. Specify the maintenance domain level by specifying the value at the **[edit protocols oam ethernet connectivity-fault-management ]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set maintenace-domain md-name level number
```

3. Create a maintenance association for the working path by specifying the name and the short name format at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name*]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name]
user@host# set maintenance-association test-ma short-name-format option
```

4. Specify the maintenance association name used for connection protection and the name of the automatic-protection-switching profile (aps-profile) at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* maintenance-association *ma-name*]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name]
user@host# set protect-maintenance-association ma-name aps-profile
  aps-profile-name
```

5. Specify the time to wait between transmissions of continuity check messages at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* maintenance-association *ma-name* continuity-check ]** hierarchy level. The duration can be one of the following values: 10 minutes(10m), 1 minute(1m), 10 seconds(10s), 1 second(1s), 100 milliseconds(100ms), or 10 milliseconds(10ms). The default value is 1 minute.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name continuity-check]
user@host# set interval option
```

6. Specify an ID for the MEP at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]**. You can specify any value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name]
user@host# set mep mep-id
```

7. Enable maintenance end point automatic discovery so the MEP can accept continuity check messages (CCMs) from all remote MEPs of the same maintenance association.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set auto-discovery
```

8. Specify the direction in which the CCM packets are transmitted for the MEP. You can specify up or down. If you specify the direction as up, CCMs are transmitted out of every logical interface that is part of the same bridging or VPLS instance except for the interface configured on the MEP. If you specify the direction as down, CCMs are transmitted only out of the interface configured on the MEP.



**NOTE:** Ports in the Spanning Tree Protocol (STP) blocking state do not block CFM packets destined to a down MEP. Ports in an STP blocking state without the continuity check protocol configured do block CFM packets.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set direction down
```



**NOTE:** Starting with Junos OS Release 12.3, for all interfaces configured on Modular Port Concentrators (MPCs) on MX Series 3D Universal Edge Routers, you no longer need to configure the `no-control-word` statement for all Layer 2 VPNs and Layer 2 circuits over which you are running CFM MEPs. For all other interfaces on MX Series routers and on all other routers and switches, you must continue to configure the `no-control-word` statement at the `[edit routing-instances routing-instance-name protocols l2vpn]` or `[edit protocols l2circuit neighbor neighbor-id interface interface-name]` hierarchy level when you configure CFM MEPs. Otherwise, the CFM packets are not transmitted, and the `show oam ethernet connectivity-fault-management mep-database` command does not display any remote MEPs.

9. Specify the interface to which the MEP is attached. It can be a physical interface, logical interface, or trunk interface. On MX Series routers, the MEP can be attached to a specific VLAN of a trunk interface. Also, specify the transport path as working.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]
user@host# set interface interface-name working
```

10. Create a maintenance association for the protection path by specifying the name and the short name format at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name]` hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name]
user@host# set maintenance-association ma-name short-name-format option
```

11. Specify the time to wait between transmissions of continuity check messages at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name continuity-check]` hierarchy level. The duration can be one of the following values: 10 minutes(10m), 1 minute(1m), 10 seconds(10s), 1 second(1s), 100 milliseconds(100ms), or 10 milliseconds(10ms). The default value is 1 minute.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name continuity-check]
user@host# set interval option
```

12. Specify an ID for the MEP at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name]`. You can specify any value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name]
user@host# set mep mep-id
```

13. Enable maintenance end point automatic discovery so the MEP can accept continuity check messages (CCMs) from all remote MEPs of the same maintenance association.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set auto-discovery
```

14. Specify the direction in which the CCM packets are transmitted for the MEP. You can specify up or down. If you specify the direction as up, CCMs are transmitted out of every logical interface that is part of the same bridging or VPLS instance except for the interface configured on the MEP. If you specify the direction as down, CCMs are transmitted only out of the interface configured on the MEP.



**NOTE:** Ports in the Spanning Tree Protocol (STP) blocking state do not block CFM packets destined to a down MEP. Ports in an STP blocking state without the continuity check protocol configured do block CFM packets.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set direction down
```



**NOTE:** Starting with Junos OS Release 12.3, for all interfaces configured on Modular Port Concentrators (MPCs) on MX Series 3D Universal Edge Routers, you no longer need to configure the `no-control-word` statement for all Layer 2 VPNs and Layer 2 circuits over which you are running CFM MEPs. For all other interfaces on MX Series routers and on all other routers and switches, you must continue to configure the `no-control-word` statement at the `[edit routing-instances routing-instance-name protocols l2vpn]` or `[edit protocols l2circuit neighbor neighbor-id interface interface-name]` hierarchy level when you configure CFM MEPs. Otherwise, the CFM packets are not transmitted, and the `show oam ethernet connectivity-fault-management mep-database` command does not display any remote MEPs.

15. Specify the interface to which the MEP is attached. It can be a physical interface, logical interface, or trunk interface. On MX Series routers, the MEP can be attached to a specific VLAN of a trunk interface. Also, specify the transport path as working.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]
user@host# set interface interface-name protect
```

#### Related Documentation

- [auto-discovery on page 882](#)
- [interval](#)
- [name-format on page 1076](#)
- [protect-maintenance-association on page 1143](#)
- [short-name-format on page 1176](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)

- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)

## Configuring a CFM Action Profile to Specify CFM Actions for CFM Events

You can create a connectivity fault management (CFM) action profile to define event flags and thresholds to be monitored. You can also specify the action to be taken when any of the configured events occur. When the CFM events occur, the router performs the corresponding action based on your specification. You can configure one or more events in the action profile. Alternatively, you can configure an action profile and specify default actions when connectivity to a remote maintenance association endpoint (MEP) fails.



**NOTE:** You cannot configure multiple actions at this time. Only one action can be configured. This limitation affects both the `action` and `clear-action` statements.

To configure the CFM action profile:

1. In configuration mode, at the `[edit protocols oam ethernet connectivity-fault-management]` hierarchy level, specify the name of the action profile and the CFM event(s). You can configure more than one event in the action profile. Possible events include: `interface-status-tlv`, `port-status-tlv`, `adjacency-loss`, `RDI`.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set action-profile profile-name event [event1, event2, event3..]
```

2. Specify the action to be taken by the router when the event occurs. The action is triggered when the event occurs. If you have configured more than one event in the action profile, it is not necessary for all events to occur to trigger the action.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set action-profile profile-name action action
```

3. Specify the default action to be taken by the router when connectivity to a remote MEP fails. If no action is configured, no action is taken.



**NOTE:** Associating an action profile with the `interface-down` action on an up MEP CFM session running over a circuit cross-connect (CCC) interface (`l2circuit/l2vpn`) is not advisable and can result in a deadlock situation.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set action-profile profile-name default-actions action
```

### Related Documentation

- [event \(CFM\)](#)
- [default-actions on page 921](#)
- [connectivity-fault-management on page 914](#)

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Linktrace Protocol in CFM

The linktrace protocol is used for path discovery between a pair of maintenance points. Linktrace messages are triggered by an administrator using the **traceroute** command to verify the path between a pair of MEPs under the same maintenance association. Linktrace messages can also be used to verify the path between an MEP and an MIP under the same maintenance domain. The linktrace protocol enables you to configure the time to wait for a response. If no response is received for a linktrace request message, the request and response entries are deleted after the interval expires. You can also configure the number of linktrace reply entries to be stored for the corresponding linktrace request.

The operation of IEEE 802.1ag linktrace request and response messages is similar to the operation of Layer 3 **traceroute** commands. For more information about the **traceroute** command, see the *Junos OS Administration Library for Routing Devices*.

To configure the linktrace protocol:

1. Configure the time to wait for a linktrace response at the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level. You can specify the value in minutes or seconds. The default value is 10 minutes.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set linktrace age time
```

2. Configure the number of linktrace reply entries to be stored per linktrace request. You can specify a value from 1 through 500. The default value is 100.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# set linktrace path-database-size path-database-size
```

### Related Documentation

- [age on page 868](#)
- [path-database-size on page 1108](#)
- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)

- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Ethernet Local Management Interface

- [Ethernet Local Management Interface Overview on page 540](#)
- [Configuring the Ethernet Local Management Interface on page 542](#)
- [Example E-LMI Configuration on page 543](#)

### Ethernet Local Management Interface Overview

Gigabit Ethernet (**ge**), 10-Gigabit Ethernet (**xe**), and Aggregated Ethernet (**ae**) interfaces support the Ethernet Local Management Interface (E-LMI).

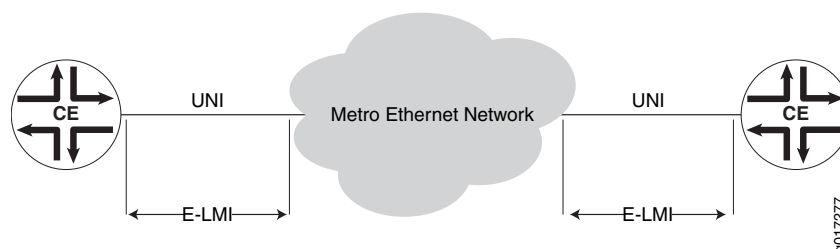


**NOTE:** On MX Series routers, E-LMI is supported on Gigabit Ethernet (**ge**), 10-Gigabit Ethernet (**xe**), and Aggregated Ethernet (**ae**) interfaces configured on MX Series routers with DPC only.

The E-LMI specification is available at the Metro Ethernet Forum. E-LMI procedures and protocols are used for enabling automatic configuration of the customer edge (CE) to support Metro Ethernet services. The E-LMI protocol also provides user-to-network interface (UNI) and Ethernet virtual connection (EVC) status information to the CE. The UNI and EVC information enables automatic configuration of CE operation based on the Metro Ethernet configuration.

The E-LMI protocol operates between the CE device and the provider edge (PE) device. It runs only on the PE-CE link and notifies the CE of connectivity status and configuration parameters of Ethernet services available on the CE port. The scope of the E-LMI protocol is shown in [Figure 34 on page 540](#).

**Figure 34: Scope of the E-LMI Protocol**





The E-LMI implementation on MX Series routers includes only the PE side of the E-LMI protocol.

E-LMI interoperates with an OAM protocol, such as Connectivity Fault Management (CFM), that runs within the provider network to collect OAM status. CFM runs at the provider maintenance level (UNI-N to UNI-N with up MEPs at the UNI). E-LMI relies on the CFM for end-to-end status of EVCs across CFM domains (SVLAN domain or VPLS).

The E-LMI protocol relays the following information:

- Notification to the CE of the addition/deletion of an EVC (active, not active, or partially active)
- Notification to the CE of the availability state of a configured EVC
- Communication of UNI and EVC attributes to the CE:
  - UNI attributes:
    - UNI identifier (a user-configured name for UNI)
    - CE-VLAN ID/EVC map type (all-to-one bundling, service multiplexing with bundling, or no bundling)
    - Bandwidth profile is not supported (including the following features):
      - CM (coupling mode)
      - CF (color flag)
      - CIR (committed Information rate)
      - CBR (committed burst size)
      - EIR (excess information rate)
      - EBS (excess burst size)
  - EVC attributes:
    - EVC reference ID
    - EVC status type (active, not active, or partially active)
    - EVC type (point-to-point or multipoint-to-multipoint)
    - EVC ID (a user-configured name for EVC)
    - Bandwidth profile (not supported)
  - CE-VLAN ID/EVC map

E-LMI on MX Series routers supports the following EVC types:

- Q-in-Q SVLAN (point-to-point or multipoint-to-multipoint)—Requires an end-to-end CFM session between UNI-Ns to monitor the EVS status.
- VPLS (BGP or LDP) (point-to-point or multipoint-to-multipoint)—Either VPLS pseudowire status or end-to-end CFM sessions between UNI-Ns can be used to monitor EVC status.

- L2 circuit/L2VPN (point-to-point)—Either VPLS pseudowire status or end-to-end CFM sessions between UNI-Ns can be used to monitor EVC status.



**NOTE:** l2-circuit and l2vpn are not supported.

## Configuring the Ethernet Local Management Interface

To configure E-LMI, perform the following steps:

- [Configuring an OAM Protocol \(CFM\) on page 542](#)
- [Assigning the OAM Protocol to an EVC on page 542](#)
- [Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC on page 542](#)

### Configuring an OAM Protocol (CFM)

For information on configuring the OAM protocol (CFM), see “[IEEE 802.1ag OAM Connectivity Fault Management Overview](#)” on page 519.

### Assigning the OAM Protocol to an EVC

To configure an EVC, you must specify a name for the EVC using the **evc***evc-id* statement at the **[edit protocols oam ethernet]** hierarchy level. You can set the EVC protocol for monitoring EVC statistics to **cfm** or **vpls** using the **evc-protocol** statement and its options at the **[edit protocols oam ethernet evcs]** hierarchy level.

You can set the number of remote UNIs in the EVC using the **remote-uni-count** *number* statement at the **[edit protocols oam ethernet evcs evcs-protocol]** hierarchy level. The **remote-uni-count** defaults to 1. Configuring a value greater than 1 makes the EVC multipoint-to-multipoint. If you enter a value greater than the actual number of endpoints, the EVC status will display as partially active even if all endpoints are up. If you enter a **remote-uni-count** less than the actual number of endpoints, the status will display as active, even if all endpoints are not up.

You can configure an EVC by including the **evcs** statement at the **[edit protocols oam ethernet]** hierarchy level:

```
[edit protocols oam ethernet]
evcs evc-id {
  evc-protocol (cfm (management-domain name management-association name) | vpls
    (routing-instance name)) {
    remote-uni-count <number>; # Optional, defaults to 1
    multipoint-to-multipoint;
    # Optional, defaults to point-to-point if remote-uni-count is 1
  }
}
```

### Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC

To configure E-LMI, include the **lmi** statement at the **[edit protocols oam ethernet]** hierarchy level:

```
[edit protocols oam ethernet]
```

```
lmi {
  polling-verification-timer value;
  # Polling verification timer (T392), defaults to 15 seconds
  status-counter count; # Status counter (N393), defaults to 4
  interface name {
    evc evc-id {
      default-evc;
      vlan-list [ vlan-ids ];
    }
    evc-map-type (all-to-one-bundling | bundling | service-multiplexing);
    polling-verification-time value; # Optional, defaults to global value
    status-counter count; # Optional, defaults to global value
    uni-id value; # Optional, defaults to interface-name
  }
}
```

You can set the status counter to count consecutive errors using the **status-counter *count*** statement at the **[edit protocols oam ethernet lmi]** hierarchy level. The status counter is used to determine if E-LMI is operational or not. The default value is 4.

You can set the **polling-verification-timer *value*** statement at the **[edit protocols oam ethernet lmi]** hierarchy level. The default value is 15 seconds.

You can enable an interface and set its options for use with E-LMI using the **interface *name*** statement at the **[edit protocols oam ethernet lmi]** hierarchy level. Only **ge**, **xe**, and **ae** interfaces are supported. You can use the interface **uni-id** option to specify a name for the UNI. If **uni-id** is not configured, it defaults to the name variable of **interface *name***.

You can specify the CE-VLAN ID/EVC map type using the **evc-map-type *type*** interface option. The options are **all-to-one-bundling**, **bundling**, or **service-multiplexing**. Service multiplexing is with no bundling. The default type is **all-to-one-bundling**.

To specify the EVC that an interface uses, use the **evc *evc-id*** statement at the **[edit protocols oam ethernet lmi interface *name*]** hierarchy level. You can specify an interface as the default EVC interface using the **default-evc** statement at the **[edit protocols oam ethernet lmi interface *name* evc *evc-id*]** hierarchy level. All VLANs that are not mapped to any other EVCs are mapped to this EVC. Only one EVC can be configured as the default.

You can map a list of VLANs to an EVC using the **vlan-list *vlan-id-list*** statement at the **[edit protocols oam ethernet lmi interface *name* evc *evc-id*]** hierarchy level.

## Example E-LMI Configuration

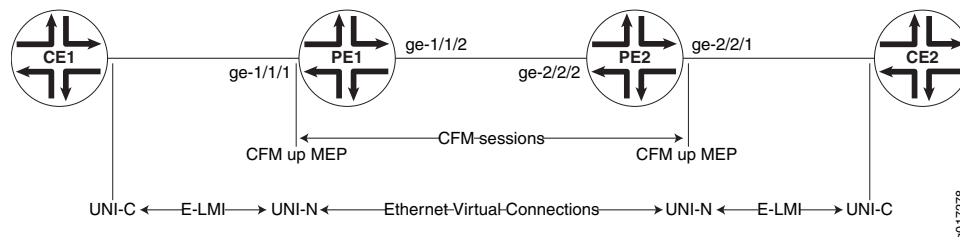
- [Example Topology on page 543](#)
- [Configuring PE1 on page 544](#)
- [Configuring PE2 on page 545](#)
- [Configuring Two UNIs Sharing the Same EVC on page 547](#)

## Example Topology

[Figure 35 on page 544](#) illustrates the E-LMI configuration for a point-to-point EVC (SVLAN) monitored by CFM. In this example, VLANs 1 through 2048 are mapped to **evc1** (SVLAN

100) and 2049 through 4096 are mapped to **evc2** (SVLAN 200). Two CFM sessions are created to monitor these EVCs.

**Figure 35: E-LMI Configuration for a Point-to-Point EVC (SVLAN) Monitored by CFM**



### Configuring PE1

```
[edit]
interfaces {
  ge-1/1/1 {
    unit 0 {
      family bridge {
        interface-mode trunk;
        vlan-id-list 1-2048;
      }
    }
    unit 1 {
      family bridge {
        interface-mode trunk;
        vlan-id-list 2049-4096;
      }
    }
  }
  ge-1/1/2 {
    unit 0 {
      vlan-id 100;
      family bridge {
        interface-mode trunk;
        inner-vlan-id-list 1-2048;
      }
    }
    unit 1 {
      vlan-id 200;
      family bridge {
        interface-mode trunk;
        inner-vlan-id-list 2049-4096;
      }
    }
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        maintenance-domain md {
          level 0;
        }
      }
    }
  }
}
```

```

        maintenance-association 1 {
            name-format vlan;
            mep 1 {
                direction up;
                interface ge-1/1/1.0 vlan 1;
            }
        }
        maintenance-association 2049 {
            name-format vlan;
            mep 1 {
                direction up;
                interface ge-1/1/1.1 vlan 2049;
            }
        }
    }
}
evcs {
    evc1 {
        evc-protocol cfm management-domain md management-association 1;
        remote-uni-count 1;
    }
    evc2 {
        evc-protocol cfm management-domain md management-association 2049;
        remote-uni-count 1;
    }
}
lmi {
    interface ge-1/1/1 {
        evc evc1 {
            vlan-list 1-2048;
        }
        evc evc2 {
            vlan-list 2049-4096;
        }
        evc-map-type bundling;
        uni-id uni-ce1;
    }
}
}
}
}

```

### Configuring PE2

```

[edit]
interfaces {
    ge-2/2/1 {
        unit 0 {
            family bridge {
                interface-mode trunk;
                vlan-id-list 1-2048;
            }
        }
        unit 1 {
            family bridge {
                interface-mode trunk;
            }
        }
    }
}

```

```

        vlan-id-list 2049-4096;
    }
}
ge-2/2/2 {
    unit 0 {
        vlan-id 100;
        family bridge {
            interface-mode trunk;
            inner-vlan-id-list 1-2048;
        }
    }
    unit 1 {
        vlan-id 200;
        family bridge {
            interface-mode trunk;
            inner-vlan-id-list 2049-4095;
        }
    }
}
}
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                maintenance-domain md {
                    level 0;
                    maintenance-association 1 {
                        name-format vlan;
                        mep 1 {
                            direction up;
                            interface ge-2/2/1.0 vlan 1;
                        }
                    }
                }
                maintenance-association 2049 {
                    name-format vlan;
                    mep 1 {
                        direction up;
                        interface ge-2/2/1.1 vlan 2049;
                    }
                }
            }
        }
    }
    evcs {
        evc1 {
            evc-protocol cfm management-domain md management-association 1;
            remote-uni-count 1;
        }
        evc2 {
            evc-protocol cfm management-domain md management-association 2049;
            uni-count 2;
        }
    }
    lmi {
        interface ge-2/2/1 {
            evc evc1 {

```

```

        vlan-list 1-2048;
    }
    evc evc2 {
        vlan-list 2049-4095;
    }
    evc-map-type bundling;
    uni-id uni-ce2;
}
}
}
}
}
}
}

```

### Configuring Two UNIs Sharing the Same EVC

```

[edit protocols]
oam {
  ethernet {
    connectivity-fault-management { ...}
    evcs {
      evc1 {
        evc-protocol cfm management-domain md management-association 1;
        remote-uni-count 1;
      }
    }
    lmi {
      interface ge-2/2/1 {
        evc evc1 {
          vlan-list 0-4095;
        }
        evc-map-type all-to-one-bundling;
        uni-id uni-ce1;
      }
      interface ge-2/3/1 {
        evc evc1 {
          vlan-list 0-4095;
        }
        evc-map-type all-to-one-bundling;
        uni-id uni-ce2;
      }
    }
  }
}
}
}
}
}
}
}

```

#### Related Documentation

- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)

- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Port Status TLV and Interface Status TLV

- [TLVs Overview on page 548](#)
- [Various TLVs for CFM PDUs on page 548](#)
- [Support for Additional Optional TLVs on page 550](#)
- [MAC Status Defects on page 556](#)
- [Configuring Remote MEP Action Profile Support on page 558](#)
- [Monitoring a Remote MEP Action Profile on page 559](#)

### TLVs Overview

Type, Length, and Value (TLVs) are described in the IEEE 802.1ag standard for CFM as a method of encoding variable-length and/or optional information in a PDU. TLVs are not aligned to any particular word or octet boundary. TLVs follow each other with no padding between them.

[Table 49 on page 548](#) shows the TLV format and indicates if it is required or optional.

**Table 49: Format of TLVs**

Parameter	Octet (sequence)	Description
Type	1	Required. If 0, no Length or Value fields follow. If not 0, at least the Length field follows the Type field.
Length	2–3	Required if the Type field is not 0. Not present if the Type field is 0. The 16 bits of the Length field indicate the size, in octets, of the Value field. 0 in the Length field indicates that there is no Value field.
Value	4	Length specified by the Length field. Optional. Not present if the Type field is 0 or if the Length field is 0.

### Various TLVs for CFM PDUs

[Table 50 on page 549](#) shows a set of TLVs defined by IEEE 802.1ag for various CFM PDU types. Each TLV can be identified by the unique value assigned to its type field. Some type field values are reserved.



Table 50: Type Field Values for Various TLVs for CFM PDUs

TLV or Organization	Type Field
End TLV	0
Sender ID TLV	1
Port Status TLV	2
Data TLV	3
Interface Status TLV	4
Reply Ingress TLV	5
Reply Egress TLV	6
LTM Egress Identifier TLV	7
LTR Egress Identifier TLV	8
Reserved for IEEE 802.1	9 to 30
Organization-Specific TLV	31
Defined by ITU-T Y.1731	32 to 63
Reserved for IEEE 802.1	64 to 255

Not every TLV is applicable for all types of CFM PDUs.

- TLVs applicable for continuity check message (CCM):
  - End TLV
  - Sender ID TLV
  - Port Status TLV
  - Interface Status TLV
  - Organization-Specific TLV
- TLVs applicable for loopback message (LBM):
  - End TLV
  - Sender ID TLV
  - Data TLV
  - Organization-Specific TLV
- TLVs applicable for loopback reply (LBR):

- End TLV
- Sender ID TLV
- Data TLV
- Organization-Specific TLV
- TLVs applicable for linktrace message (LTM):
  - End TLV
  - LTM Egress Identifier TLV
  - Sender ID TLV
  - Organization-Specific TLV
- TLVs applicable for linktrace reply (LTR):
  - End TLV
  - LTR Egress Identifier TLV
  - Reply Ingress TLV
  - Reply Egress TLV
  - Sender ID TLV
  - Organization-Specific TLV

The following TLVs are currently supported in the applicable CFM PDUs:

- End TLV
- Reply Ingress TLV
- Reply Egress TLV
- LTR Egress Identifier TLV
- LTM Egress Identifier TLV
- Data TLV

## Support for Additional Optional TLVs

The following additional optional TLVs are supported:

- Port Status TLV
- Interface Status TLV

MX Series routers support configuration of port status TLV and interface status TLV. Configuring the Port Status TLV allows the operator to control the transmission of the Port Status TLV in CFM PDUs.



**NOTE:** Although Port Status TLV configuration statements are visible in the CLI on M120 and M320 routers, Port Status TLV cannot be configured on these systems. Port Status TLV can be enabled on a MEP interface only if it is a bridge logical interface, which is not possible on these systems.

For configuration information, see the following sections:

- [Port Status TLV on page 551](#)
- [Interface Status TLV on page 553](#)

### Port Status TLV

The Port Status TLV indicates the ability of the bridge port on which the transmitting MEP resides to pass ordinary data, regardless of the status of the MAC. The value of this TLV is driven by the MEP variable **enableRmepDefect**, as shown in [Table 52 on page 551](#). The format of this TLV is shown in [Table 51 on page 551](#).

Any change in the Port Status TLVs value triggers one extra transmission of that bridge ports MEP CCMs.

**Table 51: Port Status TLV Format**

Parameter	Octet (Sequence)
Type = 2	1
Length	2–3
Value (See <a href="#">Table 52 on page 551</a> )	4

**Table 52: Port Status TLV Values**

Mnemonic	Ordinary Data Passing Freely Through the Port	Value
psBlocked	No: <b>enableRmepDefect</b> = false	1
psUp	Yes: <b>enableRmepDefect</b> = true	2

The MEP variable **enableRmepDefect** is a boolean variable indicating whether frames on the service instance monitored by the maintenance associations if this MEP are enabled to pass through this bridge port by the Spanning Tree Protocol and VLAN topology management. It is set to TRUE if:

- The bridge port is set in a state where the traffic can pass through it.
- The bridge port is running multiple instances of the spanning tree.
- The MEP interface is not associated with a bridging domain.

### Configuring Port Status TLV

Junos OS provides configuration support for the Port Status TLV, allowing you to control the transmission of this TLV in CCM PDUs. The Junos OS provides this configuration at the continuity-check level. By default, the CCM does not include the Port Status TLV. To configure the Port Status TLV, use the **port-status-tlv** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *identifier* maintenance-association *identifier* continuity-check]** hierarchy level.



**NOTE:** Port Status TLV configuration is not mandated by IEEE 802.1ag. The Junos OS provides it in order to give more flexibility to the operator; however it receives and processes CCMs with a Port Status TLV, regardless of this configuration.

An example of the configuration statements follows:

```
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        maintenance-domain identifier {
          level number;
          maintenance-association identifier {
            continuity-check {
              interval number,
              loss-threshold number;
              hold-interval number;
              port-status-tlv; # Sets Port Status TLV
            }
          }
        }
      }
    }
  }
}
```

You cannot enable Port Status TLV transmission in the following two cases:

- If the MEP interface under the maintenance-association is not of type bridge.
- If the MEP is configured on a physical interface.

### Displaying the Received Port Status TLV

The Junos OS saves the last received Port Status TLV from a remote MEP. If the received Port Status value does not correspond to one of the standard values listed in [Table 52 on page 551](#), then the **show** command displays it as "unknown." You can display the last saved received Port Status TLV using the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *identifier***

**maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 local-mep 2001 remote-mep 1001
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 2001, Direction: down, MAC address: 00:19:e2:b2:81:4a
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up
Interface name: ge-2/0/0.0, Interface status: Active, Link status: Up

Remote MEP identifier: 1001, State: ok
MAC address: 00:19:e2:b0:74:00, Type: Learned
Interface: ge-2/0/0.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none # RX PORT STATUS
Interface status TLV: none
```

### ***Displaying the Transmitted Port Status TLV***

The Junos OS saves the last transmitted Port Status TLV from a local MEP. If the transmission of the Port Status TLV has not been enabled, then the **show** command displays "none." You can display the last saved transmitted Port Status TLV using the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *identifier* maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 local-mep 2001 remote-mep 1001
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 2001, Direction: down, MAC address: 00:19:e2:b2:81:4a
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up # TX PORT STATUS
Interface name: ge-2/0/0.0, Interface status: Active, Link status: Up

Remote MEP identifier: 1001, State: ok
MAC address: 00:19:e2:b0:74:00, Type: Learned
Interface: ge-2/0/0.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: none
```

### **Interface Status TLV**

The Interface Status TLV indicates the status of the interface on which the MEP transmitting the CCM is configured, or the next-lower interface in the IETF RFC 2863 IF-MIB. The format of this TLV is shown in [Table 53 on page 554](#). The enumerated values are shown in [Table 54 on page 554](#).

Table 53: Interface Status TLV Format

Parameter	Octet (Sequence)
Type = 4	1
Length	2–3
Value (See Table 54 on page 554)	4

Table 54: Interface Status TLV Values

Mnemonic	Interface Status	Value
isUp	up	1
isDown	down	2
isTesting	testing	3
isUnknown	unknown	4
isDormant	dormant	5
isNotPresent	notPresent	6
isLowerLayerDown	lowerLayerDown	7



**NOTE:** When the operational status of a logical interface changes from the down state (status value of 2) to the lower layer down state (status value of 7) and vice versa, the LinkDown SNMP trap is not generated. For example, if you configure an aggregated Ethernet interface bundle with a VLAN tag and add a physical interface that is in the operationally down state to the bundle, the operational status of the aggregated Ethernet logical interface bundle at that point is lower layer down (7). If you take the MIC associated with the interface offline, the LinkDown trap is not generated when the logical interface shifts from the lower layer down state to the down state.

Similarly, consider another sample scenario in which an physical interface is added to an aggregated Ethernet bundle that has VLAN tagging and the aggregated Ethernet logical interface is disabled. When the logical interface is disabled, the operational status of the logical interface changes to down. If you disable the physical interface that is part of the aggregated Ethernet bundle, the operational status of the aggregated Ethernet logical interface remains down. If you reen able the aggregated Ethernet logical interface, the operational status of it changes from down to lower layer down. The LinkDown SNMP trap is not generated at this point.

### Configuring Interface Status TLV

The Junos OS provides configuration support for the Interface Status TLV, thereby allowing operators to control the transmission of this TLV in CCM PDUs through configuration at the continuity-check level.



**NOTE:** This configuration is not mandated by IEEE 802.1ag; rather it is provided to give more flexibility to the operator. The Junos OS receives and processes CCMs with the Interface Status TLV, regardless of this configuration.

The interface status TLV configuration is shown below:

```
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        maintenance-domain identifier {
          level number;
          maintenance-association identifier {
            continuity-check {
              interval number;
              loss-threshold number;
              hold-interval number;
              interface-status-tlv; # Sets the interface status TLV
            }
          }
        }
      }
    }
  }
}
```



**NOTE:** The Junos OS supports transmission of only three out of seven possible values for the Interface Status TLV. The supported values are 1, 2, and 7. However, the Junos OS is capable of receiving any value for the Interface Status TLV.

### Displaying the Received Interface Status TLV

The Junos OS saves the last received Interface Status TLV from the remote MEP. If the received Interface Status value does not correspond to one of the standard values listed in [Table 53 on page 554](#), then the **show** command displays "unknown."

You can display this last saved Interface Status TLV using the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *identifier* maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 local-mep 2001 remote-mep 1001
```

```
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 2001, Direction: down, MAC address: 00:19:e2:b2:81:4a
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up
Interface name: ge-2/0/0.0, Interface status: Active, Link status: Up

Remote MEP identifier: 1001, State: ok
MAC address: 00:19:e2:b0:74:00, Type: Learned
Interface: ge-2/0/0.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: none # displays the Interface Status TLV state
```

### ***Displaying the Transmitted Interface Status TLV***

The Junos OS saves the last transmitted Interface Status TLV from a local MEP. If the transmission of Interface Status TLV has not been enabled, then the **show** command displays "none."

You can display the last transmitted Interface Status TLV using the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *identifier* maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 local-mep 2001 remote-mep 1001
```

```
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 2001, Direction: down, MAC address: 00:19:e2:b2:81:4a
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up
Interface name: ge-2/0/0.0, Interface status: Active, Link status: Up

Remote MEP identifier: 1001, State: ok
MAC address: 00:19:e2:b0:74:00, Type: Learned
Interface: ge-2/0/0.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: none
```

## **MAC Status Defects**

The Junos OS provides MAC status defect information, indicating that one or more of the remote MEPs is reporting a failure in its Port Status TLV or Interface Status TLV. It indicates "yes" if either some remote MEP is reporting that its interface is not isUp (for example, at least one remote MEPs interface is unavailable), or if all remote MEPs are reporting a Port Status TLV that contains some value other than psUp (for example, all



remote MEPs Bridge Ports are not forwarding data). There are two **show** commands you can use to view the MAC Status Defects indication.

Use the **mep-database** command to display MAC status defects:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-association ma6
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 500, Direction: down, MAC address: 00:05:85:73:7b:39
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up
Interface name: xe-5/0/0.0, Interface status: Active, Link status: Up
Defects:
  Remote MEP not receiving CCM          : no
  Erroneous CCM received                 : no
  Cross-connect CCM received             : no
  RDI sent by some MEP                   : no
  Some remote MEP's MAC in error state   : yes # MAC Status Defects yes/no
Statistics:
  CCMs sent                             : 1658
  CCMs received out of sequence          : 0
  LBMs sent                             : 0
  Valid in-order LBRs received           : 0
  Valid out-of-order LBRs received       : 0
  LBRs received with corrupted data      : 0
  LBRs sent                             : 0
  LTMs sent                             : 0
  LTMs received                         : 0
  LTRs sent                             : 0
  LTRs received                         : 0
  Sequence number of next LTM request    : 0
  1DMs sent                             : 0
  Valid 1DMs received                   : 0
  Invalid 1DMs received                  : 0
  DMMs sent                             : 0
  DMRs sent                             : 0
  Valid DMRs received                   : 0
  Invalid DMRs received                  : 0
Remote MEP count: 1
  Identifier  MAC address  State  Interface
    200      00:05:85:73:39:4a    ok    xe-5/0/0.0
```

Use the **interfaces** command to display MAC status defects:

```
user@host> show oam ethernet connectivity-fault-management interfaces detail
Interface name: xe-5/0/0.0, Interface status: Active, Link status: Up
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
Interface status TLV: up, Port status TLV: up
MEP identifier: 500, Direction: down, MAC address: 00:05:85:73:7b:39
MEP status: running
Defects:
  Remote MEP not receiving CCM          : no
  Erroneous CCM received                 : no
  Cross-connect CCM received             : no
  RDI sent by some MEP                   : no
  Some remote MEP's MAC in error state   : yes # MAC Status Defects
```

```

yes/no
Statistics:
  CCMs sent : 1328
  CCMs received out of sequence : 0
  LBMs sent : 0
  Valid in-order LBRs received : 0
  Valid out-of-order LBRs received : 0
  LBRs received with corrupted data : 0
  LBRs sent : 0
  LTMs sent : 0
  LTMs received : 0
  LTRs sent : 0
  LTRs received : 0
  Sequence number of next LTM request : 0
  1DMs sent : 0
  Valid 1DMs received : 0
  Invalid 1DMs received : 0
  DMMs sent : 0
  DMRs sent : 0
  Valid DMRs received : 0
  Invalid DMRs received : 0
Remote MEP count: 1
  Identifier   MAC address   State   Interface
    200       00:05:85:73:39:4a   ok     xe-5/0/0.0

```

## Configuring Remote MEP Action Profile Support

Based on values of **interface-status-tlv** and **port-status-tlv** in the received CCM packets, a specific action, such as **interface-down**, can be taken using the **action-profile** options. Multiple action profiles can be configured on the router, but only one action profile can be assigned to a remote MEP.

The action profile can be configured with at least one event to trigger the action; but the action will be triggered if any one of these events occurs. It is not necessary for all of the configured events to occur to trigger **action**.

An action-profile can be applied only at the remote MEP level.

The following example shows an action profile configuration with explanatory comments added:

```

[edit protocols oam ethernet connectivity-fault-management]
action-profile tlv-action {
  event {
    # If interface status tlv with value specified in the config is received
    interface-status-tlv down|lower-layer-down;
    # If port status tlv with value specified in the config is received
    port-status-tlv blocked;
    # If connectivity is lost to the peer */
    adjacency-loss;
  }
  action {
    # Bring the interface down */
    interface-down;
  }
  default-actions interface-down;
}

```

```
# domains
maintenance-domain identifier {
    # maintenance domain level (0-7)
    level number;
    # association
    maintenance-association identifier {
        mep identifier {
            interface ge-x/y/z.w;
            remote-mep identifier {
                # Apply the action-profile for the remote MEP
                action-profile tlv-action;
            }
        }
    }
}
```

## Monitoring a Remote MEP Action Profile

You can use the **show oam ethernet connectivity-fault-management mep-database** command to view the action profile status of a remote MEP, as in the following example:

**show oam ethernet connectivity-fault-management mep-database remote-mep**  
(Action Profile Event)

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 remote-mep 200
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 100, Direction: down, MAC address: 00:05:85:73:e8:ad
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none # last status TLVs transmitted
by the router
Interface name: ge-1/0/8.0, Interface status: Active, Link status: Up

Remote MEP identifier: 200, State: ok # displays the remote MEP name and state

MAC address: 00:05:85:73:96:1f, Type: Configured
Interface: ge-1/0/8.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: lower-layer-down
Action profile: juniper # displays remote MEP's action profile identifier
Last event: Interface-status-tlv lower-layer-down # last remote MEP event

# to trigger action
Action: Interface-down, Time: 2009-03-27 14:25:10 PDT (00:00:02 ago)
# action occurrence time
```

### Related Documentation

- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)

- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring MAC Flush Message Processing in CET Mode

---

In carrier Ethernet transport (CET) mode, MX Series routers are used as provider edge (PE) routers, and Nokia Siemens Networks A2200 Carrier Ethernet Switches (referred to as E-domain devices) that run standard-based protocols are used in the access side. On the MX Series routers, VPLS pseudowires are configured dynamically through label distribution protocol (LDP). On the E-domain devices, topology changes are detected through connectivity fault management (CFM) sessions running between the E-domain devices and the MX Series PE routers. The MX Series PE routers can bring the carrier Ethernet interface down if there is CFM connectivity loss. This triggers a local MAC flush as well as a targeted label distribution protocol (T-LDP) MAC flush notification that gets sent towards the remote MX Series PEs to trigger MAC flush on them.

In CET inter-op mode, MX Series routers need to interoperate with the Nokia Siemens Networks Ax100 Carrier Ethernet access devices (referred to as A-domain devices) that run legacy protocols. Nokia Siemens Networks A4100 and A8100 devices act as an intermediate between the MX Series PE routers and A-domain devices. These intermediate devices perform interworking function (IWF) procedures so that operations administration management (OAM) sessions can be run between MX Series routers and A-domain devices. There are no VPLS pseudowires between the MX Series PE routers and the Nokia Siemens Networks A4100 and A8100 intermediate devices, so there is no LDP protocol running between the PE routers to send topology change notifications. In order to communicate topology changes, MX Series routers can trigger a MAC flush and propagate it in the core. MX Series routers can use action profiles based upon the connection protection type length value (TLV) event. The action profile brings down the carrier edge logical interface in MX Series PE routers, which will trigger a local MAC flush and also propagate the topology change to the core using LDP notification.

For VPLS there is no end-to-end connectivity monitored. The access rings are independently monitored by running CFM down multiple end points (MEPs) on the working and protection paths for each of the services between the E-domain devices and the MX Series PE routers, and between the A-domain devices and the MX Series PE routers the IWF hosted by the Nokia Siemens Networks A-4100 devices. When there is a connectivity failure on the working path, the Nokia Siemens Networks Ax200 devices

perform a switchover to the protection path, triggering a topology change notification (in the form of TLVs carried in CCM) to be sent on the active path.

**Figure 36: CET inter-op Dual Homed Topology**

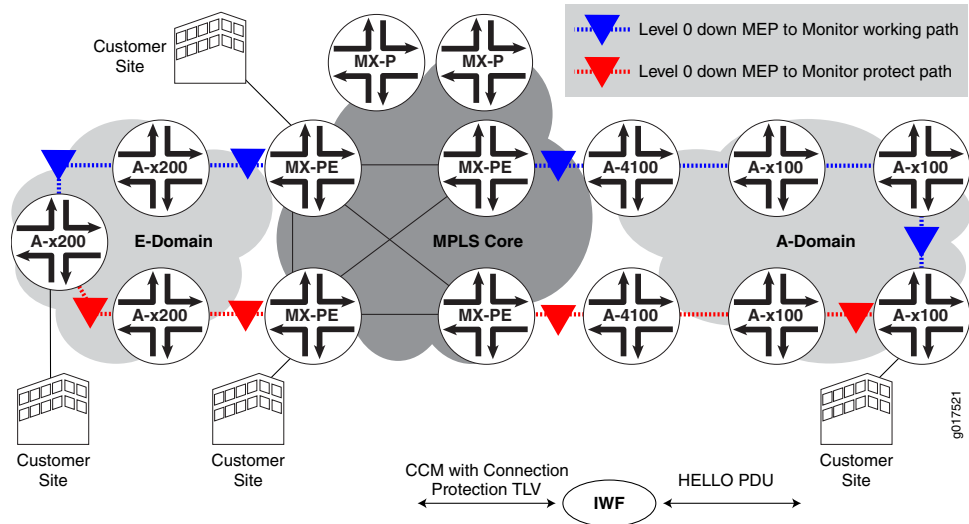


Figure 36 on page 561 describes the dual homed topology on MX Series PE routers connected to the A-domain. When an A-domain device triggers a switchover, it starts switching the service traffic to the new active path. This change is communicated in the HELLO protocol data units (PDUs) sent by that A-domain device on the working and protection paths. When the IWF in A4100 receives these HELLO PDUs, it converts them to standard CCM messages and also inserts a connection protection TLV. The "Protection-in-use" field of the connection protection TLV is encoded with the currently active path, and is included in the CCM message. CCM messages are received by the MX Series PE routers through the VLAN spoke in A4100. In the above dual homed scenario, one MX Series PE router monitors the working path, and the other MX Series PE router monitors the protection path.

A MAC flush occurs when the CFM session that is monitoring the working path detects that the service traffic has moved to the protection path or when the CFM session that is monitoring the protection path detects that the service traffic has moved to the working path.

Figure 37: CET inter-op Dual Attached Topology

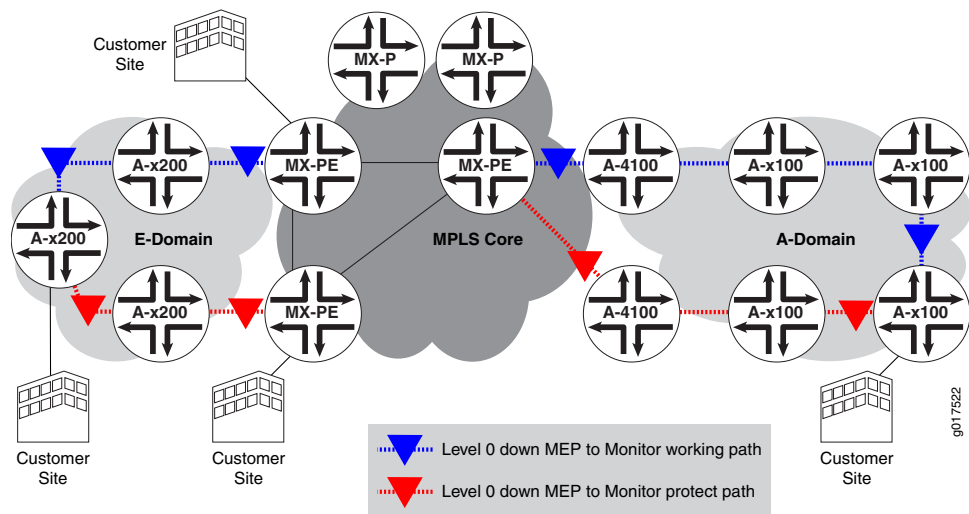


Figure 37 on page 562 describes the dual attached topology on MX Series PE routers connected to the A-domain. The MAC flush mechanism used in this case is also the same as the one used for the A-domain in the dual homed scenario (Figure 1). However in this case both the CFM sessions are hosted by only one MX Series PE router. When Ax100 in the A-domain detects topology changes, the MX Series PE router receives the connection protection TLV in the CCM message for the working and protection paths with the value of “Protection-in-use” indicating which path is the active one. Based upon the event that is generated for the CFM session, the MX Series PE router will bring down the appropriate interface which will trigger a local MAC flush.

## Configuring a Connection Protection TLV Action Profile

An action profile can be configured to perform the **interface-down** action based on the values of **connection-protection-tlv** in the received CCM packets.

The following example shows an action profile configuration with explanatory comments added:

```
[edit protocols oam ethernet connectivity-fault-management]
action-profile <tlv-action> {
  event {
    # If a connection protection TLV with a "Protection-in-use" value of SET is received */
    connection-protection-tlv <using-protection-path>;
    # If a connection protection TLV with a "Protection-in-use" value of RESET is received
    */
    connection-protection-tlv <using-working-path>;
  }
  action {
    # Bring the interface down */
    interface-down;
  }
}
```

Related Documentation • [connection-protection-tlv](#)

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Creating a Maintenance Association on page 528](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Configuring Rate Limiting of Ethernet OAM Messages on page 566](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Example: Configuring an Action Profile Based on Connection Protection TLVs

This example shows how to configure an action profile based on the connection protection TLV for the purposes of triggering MAC flushes based on topology changes in a CET network.

- [Requirements on page 563](#)
- [Overview and Topology on page 563](#)
- [Configuration on page 564](#)

### Requirements

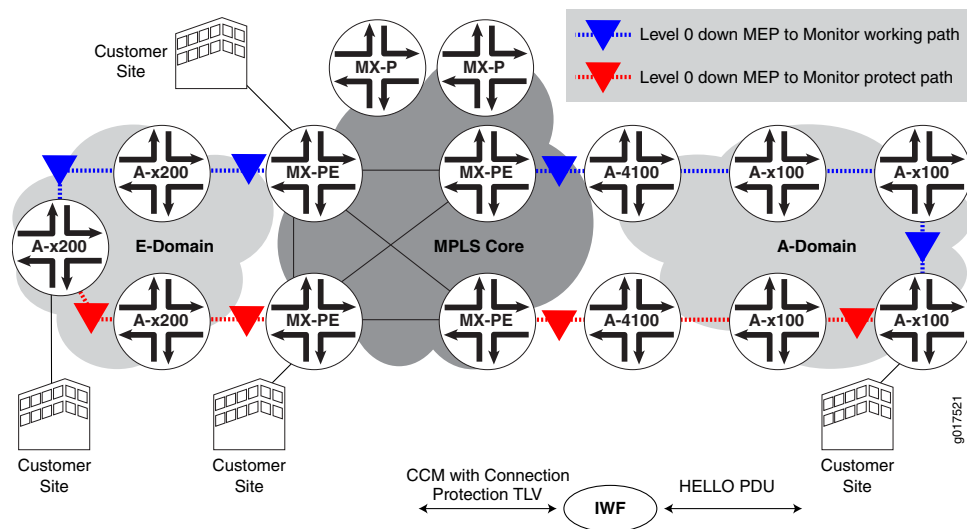
This example uses the following hardware and software components:

- Junos OS Release 11.2 or later
- A MX series PE router

### Overview and Topology

The physical topology of a CET network using MX series PE routers is shown in [Figure 38 on page 564](#)

Figure 38: Topology of CET network



The following definitions describe the meaning of the device abbreviation and terms used in [Figure 38 on page 564](#).

- Provider edge (PE) device—A device, or set of devices, at the edge of the provider network that presents the provider's view of the customer site.
- E-domain—Nokia Siemens Networks Carrier Ethernet Switches that run standard based protocols and are used in the access side.
- A-domain—Nokia Siemens Networks Carrier Ethernet Switches that run legacy protocols.

## Configuration

### Step-by-Step Procedure

To configure an action profile based on the connection protection TLV, perform these tasks:

1. Configure an action profile
 

```
[edit protocols oam ethernet connectivity-fault-management]
action-profile <tlv-action> {
  event {
```
2. If the connection protection TLV is received with a "Protection-in-use" value of SET, then the connection protection TLV should use the protection path
 

```
connection-protection-tlv <using-protection-path>;
```
3. If the connection protection TLV is received with a "Protection-in-use" value of RESET, then the connection protection TLV should use the working path
 

```
connection-protection-tlv <using-working-path>;
}
```
4. Configure the action profile to bring the interface down
 

```
action {
  /* Bring the interface down */
```



```

        interface-down;
    }
}

```

**Results** Check the results of the configuration

```

[edit protocols oam ethernet connectivity-fault-management]
action-profile <tlv-action> {
  event {
    connection-protection-tlv <using-protection-path>;
    connection-protection-tlv <using-working-path>;
  }
  action {
    interface-down;
  }
}

```

**Related Documentation**

- [connection-protection-tlv](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)

## Configuring M120 and MX Series Routers for CCC Encapsulated Packets

- [IEEE 802.1ag CFM OAM Support for CCC Encapsulated Packets Overview on page 565](#)
- [CFM Features Supported on Layer 2 VPN Circuits on page 565](#)
- [Configuring CFM for CCC Encapsulated Packets on page 566](#)

### IEEE 802.1ag CFM OAM Support for CCC Encapsulated Packets Overview

Layer 2 virtual private network (L2VPN) is a type of virtual private network service used to transport customer's private Layer 2 traffic (for example, Ethernet, ATM or Frame Relay) over the service provider's shared IP/MPLS infrastructure. The service provider edge (PE) router must have an interface with circuit cross-connect (CCC) encapsulation to switch the customer edge (CE) traffic to the public network.

The IEEE 802.1ag Ethernet Connectivity Fault Management (CFM) is an OAM standard used to perform fault detection, isolation, and verification on virtual bridge LANs. M120 and MX Series routers provide CFM support for bridge/VPLS/routed interfaces and support 802.1ag Ethernet OAM for CCC encapsulated packets.

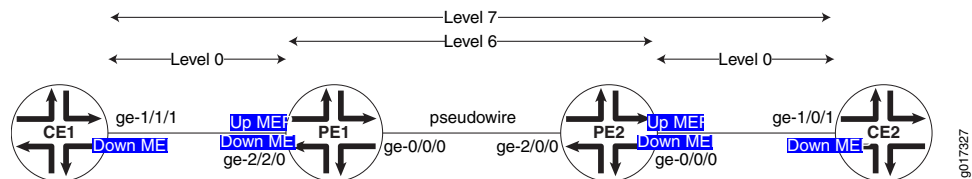
### CFM Features Supported on Layer 2 VPN Circuits

CFM features supported on L2VPN circuits are as follows:

- Creation of up/down MEPs at any level on the CE-facing logical interfaces.
- Creation of MIPs at any level on the CE-facing logical interfaces.
- Support for continuity check, loopback, and linktrace protocol.

- Support for the Y1731 Ethernet Delay measurement protocol.
- Support for action profiles to bring the CE-facing logical interfaces down when loss of connectivity is detected.

Figure 39: Layer 2 VPN Topology



To monitor the L2VPN circuit, a CFM up MEP (Level 6 in Figure 39 on page 566) can be configured on the CE-facing logical interfaces of provider edge routers PE1 and PE2. To monitor the CE-PE attachment circuit, a CFM down MEP can be configured on the customer logical interfaces of CE1-PE1 and CE2-PE2 (Level 0 in Figure 39 on page 566).

## Configuring CFM for CCC Encapsulated Packets

The only change from the existing CLI configuration is the introduction of a new command to create a MIP on the CE-facing interface of the PE router.

```
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        # Define a maintenance domains for each default level.
        #; These names are specified as DEFAULT_level_number
        maintenance-domain DEFAULT_x {
          # L2VPN CE interface
          interface (ge | xe)-fpc/pic/port.domain;
        }
      }
      level number;
      maintenance-association identifier {
        mep mep-id {
          direction (up | down);
          # L2 VPN CE interface on which encapsulation family CCC is configured.
          interface (ge | xe)-fpc/pic/port.domain;
          auto-discovery;
          priority number;
        }
      }
    }
  }
}
```

## Configuring Rate Limiting of Ethernet OAM Messages

The M320 with Enhanced III FPC, M120, M7i, M10 with CFEB, and MX Series routers support rate limiting of Ethernet OAM messages. Depending on the connectivity fault management

(CFM) configuration, CFM packets are discarded, sent to the CPU for processing, or flooded to other bridge interfaces. This feature allows the router to intercept incoming CFM packets for prevention of DoS attacks.

You can apply rate limiting of Ethernet OAM messages at either of two CFM policing levels, as follows:

- Global-level CFM policing—uses a policer at the global level to police the CFM traffic belonging to all the sessions.
- Session-level CFM policing—uses a policer created to police the CFM traffic belonging to one session.

To configure global-level CFM policing, include the **policer** statement and its options at the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level.

To configure session-level CFM policing, include the **policer** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* level *number* maintenance-association *ma-name*]** hierarchy level.

The following example shows a CFM policer used for rate-limiting CFM:

```
[edit]
firewall {
  policer cfm-policer {
    if-exceeding {
      bandwidth-limit 8k;
      burst-size-limit 2k;
    }
    then discard;
  }
}
```

#### Case 1: Global-Level CFM Policing

This example shows a global level policer, at the CFM level, for rate-limiting CFM. The **continuity-check *cfm-policer*** statement at the global **[edit protocols oam ethernet connectivity-fault-management policer]** hierarchy level specifies the policer to use for policing all continuity check packets of the CFM traffic belonging to all sessions. The **other *cfm-policer1*** statement at the **[edit protocols oam ethernet connectivity-fault-management policer]** hierarchy level specifies the policer to use for policing all non-continuity check packets of the CFM traffic belonging to all sessions. The **all *cfm-policer2*** statement specifies to police all CFM packets with the specified policer *cfm-policer2*. If the **all *policer-name*** option is used, then the user cannot specify the previous **continuity-check** and **other** options.

```
[edit protocols oam ethernet]
connectivity-fault-management {
  policer {
    continuity-check cfm-policer;
    other cfm-policer1;
    all cfm-policer2;
  }
}
```

**Case 2: Session-Level  
CFM Policing**

This example shows a session-level CFM policer used for rate-limiting CFM. The **policer** statement at the session **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* maintenance-association *ma-name*]** hierarchy level specifies the policer to use for policing only continuity check packets of the CFM traffic belonging to the specified session. The **other *cfm-policer1*** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* maintenance-association *ma-name*]** hierarchy level specifies the policer to use for policing all non-continuity check packets of the CFM traffic belonging to this session only. The **all *cfm-policer2*** statement specifies to police all CFM packets with the specified policer *cfm-policer2*. If the **all *policer-name*** option is used, then the user cannot specify the previous **continuity-check** and **other** options.

```
[edit protocols oam ethernet]
connectivity-fault-management {
  maintenance-domain md {
    level number;
    maintenance-association ma {
      continuity-check {
        interval ls;
      }
      policer {
        continuity-check cfm-policer;
        other cfm-policer1;
        all cfm-policer2;
      }
    }
  }
  mep 1 {
    interface ge-3/3/0.0;
    direction up;
    auto-discovery;
  }
}
```

In the case of global CFM policing, the same policer is shared across multiple CFM sessions. In per-session CFM policing, a separate policer must be created to rate-limit packets specific to that session.

**NOTE:**

Service-level policer configuration for any two CFM sessions on the same interface at different levels must satisfy the following constraints if the direction of the sessions is the same:

- If one session is configured with **policer all**, then the other session cannot have a **policer all** or **policer other** configuration.
- If one session is configured with **policer other**, then the other session cannot have a **policer all** or **policer other** configuration.

A commit error will occur if such a configuration is committed.



**NOTE:** Policers with PBB and MIPs are not supported.

#### Related Documentation

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Domain on page 525](#)
- [Configuring Maintenance Intermediate Points \(MIPs\) on page 526](#)
- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [Configuring Linktrace Protocol in CFM on page 539](#)
- [Configuring Ethernet Local Management Interface on page 540](#)
- [Configuring Port Status TLV and Interface Status TLV on page 548](#)
- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 565](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring Unified ISSU for 802.1ag CFM

A unified in-service software upgrade (ISSU) enables you to upgrade between two different Junos OS releases with no disruption on the control plane and with minimal disruption of traffic. Unified ISSU is automatically enabled for the Connectivity Fault Management (CFM) protocols and interoperates between local and remote maintenance endpoints (MEPs).

The Junos OS provides support for unified ISSU using the loss threshold type length value (TLV), which is automatically enabled for CFM. TLVs are described in the IEEE 802.1ag standard for CFM as a method of encoding variable-length and optional information in a protocol data unit (PDU). The loss threshold TLV indicates the loss threshold value of a remote MEP. The loss threshold TLV is transmitted as part of the CFM continuity check messages.



**NOTE:** Configuring ISSU with CFM (802.1ag) is supported only on MX and PTX routers that support TLV. Interoperation with other vendors is not supported.

During a unified ISSU, the control plane may go down for several seconds and cause CFM continuity check packets to get dropped. This may cause the remote MEP to detect a connectivity loss and mark the MEP as down. To keep the MEP active during a unified ISSU, the loss threshold TLV communicates the minimum threshold value the receiving MEP requires to keep the MEP active. The receiving MEP parses the TLV and updates the

loss threshold value, but only if the new threshold value is greater than the locally configured threshold value.

An overview of CFM is described starting in “[IEEE 802.1ag OAM Connectivity Fault Management Overview](#)” on page 519, and you should further observe the additional requirements described in this topic.

[Table 55 on page 570](#) shows the Loss Threshold TLV format.

**Table 55: Loss Threshold TLV Format**

Parameter	Octet (sequence)	Description
Type=31	1	Required. Required. If 0, no Length or Value fields follow. If not 0, at least the Length field follows the Type field.
Length=12	2	Required if the Type field is not 0. Not present if the Type field is 0. The 16 bits of the Length field indicate the size, in octets, of the Value field. 0 in the Length field indicates that there is no Value field.
OUI	3	Optional. Organization unique identifier (OUI), which is controlled by the IEEE and is typically the first three bytes of a MAC address (Juniper OUI 0x009069).
Subtype	1	Optional. Organizationally defined subtype.
Value	4	Optional. Loss threshold value.
Flag	4	Optional. Bit0 (identifies an ISSU is in progress) Bit1-31 (reserved)

Junos OS provides configuration support for the **convey-loss-threshold** statement, allowing you to control the transmission of the loss threshold TLV in continuity check messages PDUs. The **convey-loss-threshold** statement specifies that the loss threshold TLV must be transmitted as part of the continuity check messages. If the **convey-loss-threshold** statement is not specified, continuity check messages transmit this TLV only when a unified ISSU is in progress. The Junos OS provides this configuration at the continuity-check level. By default, continuity check messages do not include the loss threshold TLV.

To configure the convey loss threshold, use the **convey-loss-threshold** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *identifier* maintenance-association *identifier* continuity-check]** hierarchy level.

For the remote MEP, the loss threshold TLV is transmitted only during the unified ISSU if the **convey-loss-threshold** statement is not configured. The remote MEP switches back to the default loss threshold if no loss threshold TLV is received or the TLV has a default threshold value of 3.

An example of the ISSU configuration statements follows:

```
protocols {
```

```

oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain identifier {
        level number;
        maintenance-association identifier {
          continuity-check {
            convey-loss-threshold;
            interval number;
            loss-threshold number;
            hold-interval number;
          }
        }
      }
    }
  }
}

```

The Junos OS saves the last received loss threshold TLV from the remote MEP. You can display the last saved loss threshold TLV that is received by the remote MEP, using the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *identifier* maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md3 maintenance-association ma5 local-mep 2 remote-mep 1
Maintenance domain name: md3, Format: string, Level: 3
Maintenance association name: ma3, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 2, Direction: up, MAC address: 00:19:e2:b0:76:be
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: yes
  Prefer me: no, Protection in use: no, FRR Flag: no
Interface name: xe-4/1/1.0, Interface status: Active, Link status: Up
Loss Threshold TLV:
  Loss Threshold: 3 , Flag: 0x0

Remote MEP identifier: 1, State: ok
MAC address: 00:1f:12:b7:ce:79, Type: Learned
Interface: xe-4/1/1.0
Last flapped: Never
Continuity: 100%, Admin-enable duration: 45sec, Oper-down duration: 0sec
Effective loss threshold: 3 frames
Remote defect indication: false
Port status TLV: none
Interface status TLV: none
Connection Protection TLV:
  Prefer me: no, Protection in use: no, FRR Flag: no
Loss Threshold TLV:  #Displays last received value
  Loss Threshold: 3 , Flag: 0x0

```

The Junos OS saves the last transmitted loss threshold TLV from a local MEP. You can display the last transmitted loss threshold TLV and the effective loss (operational) threshold for the remote MEP, using the **show oam ethernet connectivity-fault-management**

**mep-database maintenance-domain *identifier* maintenance-association *identifier* local-mep *identifier* remote-mep *identifier*** command, as in the following example:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md3 maintenance-association ma5 local-mep 2 remote-mep 1
Maintenance domain name: md3, Format: string, Level: 3
Maintenance association name: ma3, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 2, Direction: up, MAC address: 00:19:e2:b0:76:be
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: yes
  Prefer me: no, Protection in use: no, FRR Flag: no
Interface name: xe-4/1/1.0, Interface status: Active, Link status: Up
Loss Threshold TLV:  #Displays last transmitted value
  Loss Threshold: 3 , Flag: 0x0

Remote MEP identifier: 1, State: ok
MAC address: 00:1f:12:b7:ce:79, Type: Learned
Interface: xe-4/1/1.0
Last flapped: Never
Continuity: 100%, Admin-enable duration: 45sec, Oper-down duration: 0sec
Effective loss threshold: 3 frames  #Displays operational threshold
Remote defect indication: falsePort status TLV: none
Interface status TLV: none
Connection Protection TLV:
  Prefer me: no, Protection in use: no, FRR Flag: no
Loss Threshold TLV:
  Loss Threshold: 3 , Flag: 0x0
```

- Related Documentation**
- [Example: Configuring Ethernet CFM over VPLS on page 583](#)
  - [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)

## Configuring Continuity Check Messages for Better Scalability

This topic describes how to configure CCM for better scalability. Junos OS provides enhancements to trigger faster protection-switching and convergence in the event of failures in Ethernet domains for Carrier Ethernet services. These enhancements can be used when CE devices in the Ethernet domain detect faster service failures and propagates the information in the interface-status TLV of the continuity-check messages (CCMs). When CCMs are received, PE devices can perform certain actions which facilitates faster protection-switching and convergence.

To configure CCM for better scalability:

- You can apply an action profile to provide faster protection switching for point-to-point network topologies with local switching configured. See [“Configuring Faster Protection Switching for Point-to-Point Network Topologies” on page 573](#).
- You can apply an action profile to provide faster convergence for dual-homed multipoint-to-multipoint network topologies. See [“Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies” on page 575](#).



- You can assign a primary virtual LAN (VLAN) ID in the maintenance association for increased flexibility in the number of tags. See [“Configuring a Primary VLAN ID for Increased Flexibility” on page 576](#).
- You can configure a maintenance association to accept a different maintenance association identifier (ID) from a neighbor by including a **remote-maintenance-association** statement. See [“Configuring a Remote Maintenance Association to Accept a Different ID” on page 577](#).

**Related Documentation**

- [Configuring Faster Protection Switching for Point-to-Point Network Topologies on page 573](#)
- [Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies on page 575](#)
- [Configuring a Primary VLAN ID for Increased Flexibility on page 576](#)
- [Configuring a Remote Maintenance Association to Accept a Different ID on page 577](#)

## Configuring Faster Protection Switching for Point-to-Point Network Topologies

You can apply an action profile to provide faster protection switching for point-to-point network topologies with local switching configured. In a normal state, CCM sessions are configured on the working and protect interfaces. The CCM packets transmitted contain an interface-status TLV with the value up on the working interface and value down on the protect interface. When a link fails on the working interface, the protect interface starts receiving the interface-status TLV as up. With the profile configuration, if the interface-status TLV received on the protect interface is up, the working interface is automatically marked as **interface-down**.

To configure the **interface-status-tlv down** event, include the **interface-status-tlv down** statement at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* event]** hierarchy level.

To configure **interface-down** as the action profile's action, include the **interface-down** statement at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* action]** hierarchy level.

To configure **interface-down *peer-interface*** as the clear-action, include **interface-down *peer-interface*** at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* clear-action]** hierarchy level.

```
[edit protocols oam]
ethernet {
  connectivity-fault-management {
    action-profile p1 {
      event {
        interface-status-tlv down;
      }
      action {
        interface-down;
      }
    }
  }
}
```

```
        clear-action {  
            interface-down peer-interface;  
        }  
    }  
}
```

In this action profile configuration, when the interface-status TLV is received as up, the *peer-interface* is marked as down.

The *peer-interface* is configured in the **protect-maintenance-association** statement. Consider the following example using the **protect-maintenance-association** statement in the configuration:

```
[edit protocols oam]  
ethernet {  
    connectivity-fault-management {  
        action-profile p1 {  
            event {  
                adjacency-loss;  
            }  
            action {  
                interface-down;  
            }  
            clear-action {  
                interface-down peer-interface;  
            }  
        }  
    }  
    maintenance-domain nsn {  
        level 5;  
        maintenance-association ma1 {  
            protect-maintenance-association ma2;  
            continuity-check {  
                interval 100ms;  
                connection-protection-tlv;  
            }  
            mep 100 {  
                interface ge-1/1/0.0;  
                direction down;  
                auto-discovery;  
            }  
        }  
        maintenance-association ma2 {  
            continuity-check {  
                interval 100ms;  
                connection-protection-tlv;  
            }  
            mep 101 {  
                interface ge-1/2/0.0;  
                direction down;  
                auto-discovery;  
            }  
            remote-mep 100  
                action-profile p1;  
        }  
    }  
}
```

```
    }
  }
```

#### Related Documentation

- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)

## Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies

You can apply an action profile to provide faster convergence for dual-homed multipoint-to-multipoint network topologies. If a multipoint-to-multipoint Ethernet service uses MAC-based forwarding and stale MAC addresses exist in the learning tables, this can result in traffic black holes in the network where incoming traffic is silently discarded, without informing the source that the data did not reach its intended recipient. With the profile configuration, if the interface-status TLV received on the protect interface is up, then the interface-status TLV on the working interface is marked as down and the PE device for the protect interface propagates a remote MAC-flush message to the PE devices in the virtual private LAN service (VPLS) by using TLDP-MAC-FLUSH. The MAC flush avoids traffic blackholing due to stale mac-db entries.

To configure the **interface-status-tlv** down event, include the **interface-status-tlv down** statement at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* event]** hierarchy level.

To configure **propagate-remote-flush** as the action profile's action, include the **propagate-remote-flush** statement at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* action]** hierarchy level.

To configure **propagate-remote-flush** as the clear-action, include the **propagate-remote-flush** statement at the **[edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* clear-action]** hierarchy level.

```
[edit protocols oam]
ethernet {
  connectivity-fault-management {
    action-profile test {
      event {
        interface-status-tlv down;
      }
      action {
        propagate-remote-mac-flush;
      }
      clear-action {
        propagate-remote-mac-flush;
      }
    }
  }
}
```

In this action profile configuration, when the incoming CCM packet contains the interface-status TLV with value down, the **propagate-remote-mac-flush** action is triggered for the action-profile.

**Related  
Documentation**

- [Configuring MAC Flush Message Processing in CET Mode on page 560](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [connectivity-fault-management on page 914](#)
- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)

---

## Configuring a Primary VLAN ID for Increased Flexibility

You can assign a primary virtual LAN (VLAN) ID in the maintenance association for increased flexibility in the number of tags. When a **vlan-range** or **vlan-id-list** is configured on an interface, the service OAM must run on one of the VLANs. The VLAN assigned for service monitoring is considered the primary VLAN. If a **primary-vid** is not configured, Junos OS assigns the first VLAN from the **vlan-range** or **vlan-id-list**. In earlier releases, Junos OS assigned VLAN 4095.

To configure a primary VLAN ID, you can specify the **primary-vid** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management]
maintenance domain md3 {
  level 3;
  maintenance-association ma3 {
    primary-vid 2000;
    continuity-check {
      interval 10ms;
      connection-protection-tlv;
    }
    mep 2 {
      interface ge-2/2/0.0;
      direction up;
      auto-discovery;
    }
  }
}
```

**Related  
Documentation**

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [connection-protection-tlv](#)
- [Creating a Maintenance Association on page 528](#)
- [connectivity-fault-management on page 914](#)

## Configuring a Remote Maintenance Association to Accept a Different ID

You can configure a maintenance association to accept a different maintenance association identifier (ID) from a neighbor by including a **remote-maintenance-association** statement. The 802.1ag CCM sessions expect the same maintenance association identifier from its neighbors. If there is a maintenance association identifier mismatch, the PDUs are marked as error PDUs. If a **remote-maintenance-association** statement is configured, a different maintenance association identifier is accepted and the 802.1ag CCM sessions do not mark the CCM PDUs as error PDUs when the maintenance-association name is the same as the name specified in the **remote-maintenance-association** statement.

To configure a remote maintenance association, include the **remote-maintenance-association** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management]
maintenance domain md3 {
  level 1;
  maintenance-association ma3 {
    remote-maintenance-association fix-ma;
    continuity-check {
      interval 10ms;
      connection-protection-tlv;
    }
    mep 2 {
      interface ge-2/2/0.0;
      direction up;
      auto-discovery;
    }
  }
}
```

Using this configuration, interoperability is improved for CCMs with low-end CE devices supporting fixed maintenance association identifier configurations.

### Related Documentation

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- [Creating a Maintenance Association on page 528](#)
- [connectivity-fault-management on page 914](#)
- [connection-protection-tlv](#)

## Example: Configuring Ethernet CFM on Physical Interfaces

This example shows the configuration of Ethernet connectivity fault management (CFM) on physical interfaces.

- [Requirements on page 578](#)
- [Overview on page 578](#)
- [Configuration on page 578](#)

## Requirements

This example uses the following hardware and software components:

- Junos OS Release 9.3 or later.

## Overview

CFM can be used to monitor the physical link between two routers. This functionality is similar to that supported by the IEEE 802.3ah LFM protocol.

In Junos OS Release 9.3 and later, CFM also supports aggregated Ethernet interfaces. On interfaces configured on Modular Port Concentrators (MPCs) and Modular Interface Cards (MICs) on MX Series routers, CFM is not supported on untagged aggregated Ethernet member links. MPCs and MICs do support CFM on untagged and tagged aggregated Ethernet logical interfaces.

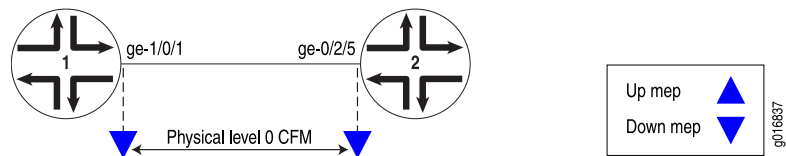


**NOTE:** The configurations in this example are only partial examples of complete and functional router configurations. Do not copy these configurations and use them directly on an actual system.

## Configuration

In the following example, two routers (Router 1 and Router 2) are connected by a point-to-point Gigabit Ethernet link. The link between these two routers is monitored using CFM. This is shown in [Figure 40 on page 578](#). The single boundary is a “down mep” in CFM terminology.

**Figure 40: Ethernet CFM on Physical Interfaces**



To configure Ethernet CFM on physical interfaces, perform these tasks:

### Quick Configuration

Configure the interface and CFM:

```
[edit]
interfaces ge-1/0/1 {
  unit 0 {
    family inet;
  }
}

protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        maintenance-domain private {
```

```

        level 0;
        maintenance-association private-ma {
            continuity-check {
                interval 1s;
            }
            mep 100 {
                interface ge-1/0/1;
                direction down;
                auto-discovery;
            }
        }
    }
}

```

The configuration on Router 2 mirrors that on Router 1, with the exception of the *mep-id*.

**Router 2** Configure the interface and CFM:

```

[edit]
interfaces ge-0/2/5 {
    unit 0 {
        family inet;
    }
}

protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                maintenance-domain private {
                    level 0;
                    maintenance-association private-ma {
                        continuity-check {
                            interval 1s;
                        }
                        mep 200 {
                            interface ge-0/2/5;
                            direction down;
                            auto-discovery;
                        }
                    }
                }
            }
        }
    }
}

```

To verify that the physical interface is configured correctly for CFM, use the **show interface** command. To verify the CFM configuration, use one or more of the **show oam ethernet connectivity-fault-management** commands listed in the [CLI Explorer](#).

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Ethernet Operations, Administration, and Maintenance on page 518](#)
- *Ethernet OAM Connectivity Fault Management*
- [Example: Configuring Ethernet CFM over VPLS on page 583](#)
- [Example: Configuring Ethernet CFM on Bridge Connections on page 580](#)

**Example: Configuring Ethernet CFM on Bridge Connections**

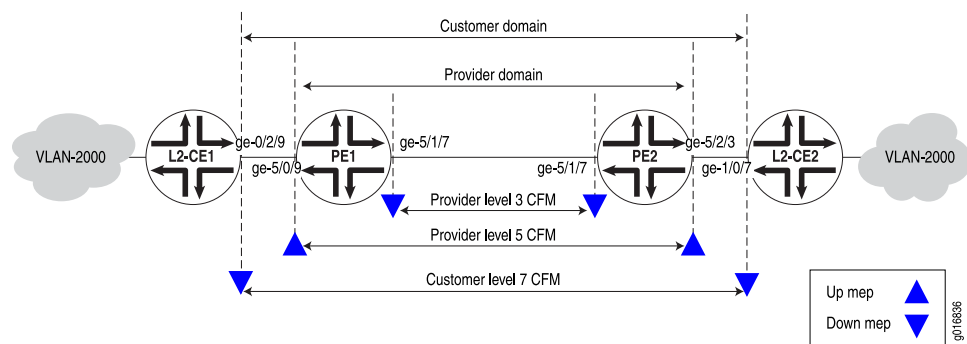
In this example, both the customer and service provider are running Ethernet CFM over a simple bridge network. The network is shown in [Figure 41 on page 580](#). The customer has configured Ethernet CFM on MX Series routers L2-CE1 and L2-CE2. The service provider has configured Ethernet CFM on MX Series routers PE1 and PE2.



**NOTE:** The configurations in this example are only partial examples of complete and functional router configurations. Do not copy these configurations and use them directly on an actual system.

The service provider is using CFM level 3 for the link between PE1 and PE2 and level 5 from one CE facing port to the other. The customer is using CFM level 7. The boundaries are marked with “up mep” and “down mep” CFM terminology in the figure.

**Figure 41: Ethernet CFM over a Bridge Network**



Here are the configurations of CFM on the customer routers.

**CFM on L2-CE1**

```
[edit interfaces]
ge-0/2/9 {
  vlan-tagging;
  unit 0 {
    vlan-id 2000;
  }
}

[edit protocols oam ethernet]
connectivity-fault-management {
  maintenance-domain customer {
```



```

level 7;
maintenance-association customer-site1 {
  continuity-check {
    interval 1s;
  }
  mep 700 {
    interface ge-0/2/9.0;
    direction down;
    auto-discovery;
  }
}
}
}

```

**CFM on L2-CE2**

```

[edit interfaces]
ge-1/0/7 {
  vlan-tagging;
  unit 0 {
    vlan-id 2000;
  }
}

[edit protocols oam ethernet]
connectivity-fault-management {
  maintenance-domain customer {
    level 7;
    maintenance-association customer-site2 {
      continuity-check {
        interval 1s;
      }
      mep 800 {
        interface ge-1/0/7.0;
        direction down;
        auto-discovery;
      }
    }
  }
}
}

```

Here are the configurations of CFM on the provider routers.

**CFM on PE1**

```

[edit interfaces]
ge-5/0/9 {
  vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 0 {
    encapsulation vlan-bridge;
    vlan-id 2000;
  }
}
ge-5/1/7 {
  vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 0 {
    encapsulation vlan-bridge;
    vlan-id 2000;
  }
}

```

```
    }
  }

[edit bridge-domains]
bridge-vlan2000 {
  domain-type bridge;
  vlan-id 2000;
  interface ge-5/0/9.0;
  interface ge-5/1/7.0;
}

[edit protocols oam ethernet connectivity-fault-management]
maintenance-domain provider-outer {
  level 5;
  maintenance-association provider-outer-site1 {
    continuity-check {
      interval 1s;
    }
    mep 200 {
      interface ge-5/0/9.0;
      direction up;
      auto-discovery;
    }
  }
}
}
maintenance-domain provider-inner {
  level 3;
  maintenance-association provider-inner-site1 {
    continuity-check {
      interval 1s;
    }
    mep 200 {
      interface ge-5/1/7.0;
      direction down;
      auto-discovery;
    }
  }
}
}
```

**CFM on PE2**

```
[edit interfaces]
ge-5/1/7 {
  vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 0 {
    encapsulation vlan-bridge;
    vlan-id 2000;
  }
}
ge-5/2/3 {
  vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 0 {
    encapsulation vlan-bridge;
    vlan-id 2000;
  }
}
```

```

}

[edit bridge-domains]
bridge-vlan2000 {
  domain-type bridge;
  interface ge-5/2/3.0;
  interface ge-5/1/7.0;
}

[edit protocols oam ethernet connectivity-fault-management]
maintenance-domain provider-outer {
  level 5;
  maintenance-association provider-outer-site1 {
    continuity-check {
      interval 1s;
    }
    mep 100 {
      interface ge-5/2/3.0;
      direction up;
      auto-discovery;
    }
  }
}
maintenance-domain provider-inner {
  level 3;
  maintenance-association provider-inner-site1 {
    continuity-check {
      interval 1s;
    }
    mep 100 {
      interface ge-5/1/7.0;
      direction down;
      auto-discovery;
    }
  }
}
}

```

#### Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Ethernet Operations, Administration, and Maintenance on page 518](#)
- *Ethernet OAM Connectivity Fault Management*
- [Example: Configuring Ethernet CFM over VPLS on page 583](#)
- [Example: Configuring Ethernet CFM on Physical Interfaces on page 577](#)

## Example: Configuring Ethernet CFM over VPLS

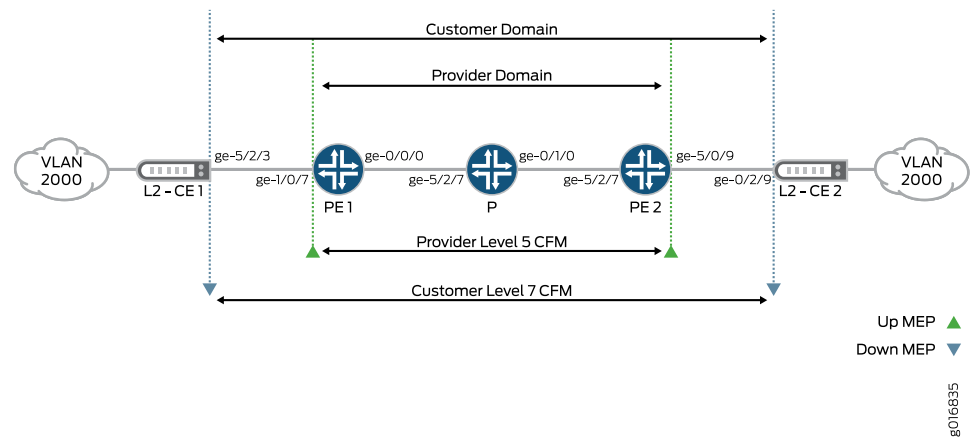
In this example, both the customer and service provider are running Ethernet CFM over a VPLS and a multiprotocol label switching (MPLS) network. The network is shown in [Figure 42 on page 584](#). The customer has configured Ethernet CFM on MX Series routers L2-CE1 and L2-CE2. The service provider has configured Ethernet CFM on MX Series routers PE1, P, and PE2.



**NOTE:** The configurations in this example are only partial examples of complete and functional router configurations. Do not copy these configurations and use them directly on an actual system.

The service provider is using CFM level 5 and the customer is using CFM level 7. The boundaries are marked with “up mep” and “down mep” CFM terminology in the figure.

**Figure 42: Ethernet OAM with VPLS**



**NOTE:** The logical interfaces in a VPLS routing instance might have the same or different VLAN configurations. VLAN normalization is required to switch packets correctly among these interfaces. Normalization supports automatic mapping of VLANs and performs operations on VLAN tags to achieve the desired translation. See *Configuring a Normalized VLAN for Translation or Tagging*.

**NOTE:**

The following forwarding path considerations must be observed:

- Packet receive path:
  - This is the forwarding path for packets received on the interfaces.
  - 802.1ag Ethernet OAM for VPLS uses implicit interface filters and forwarding table filters to flood, accept, and drop the CFM packets.
- Packet transmit path:
  - Junos OS uses the router's hardware-based forwarding for CPU-generated packets.
  - For down MEPs, the packets are transmitted on the interface on which the MEP is configured.
  - In MX series routers, for up MEPs, the packets must be flooded to other interfaces in the VPLS routing instance. The router creates a flood route tied to a flood next hop (with all interfaces to flood) and then sources the packets to be forwarded with this flood route.

The following are the configurations of the VPLS and CFM on the service provider routers.

**Configuration of PE1**

```
[edit chassis]
fpc 5 {
  pic 0 {
    tunnel-services {
      bandwidth lg;
    }
  }
}

[edit interfaces]
ge-1/0/7 {
  encapsulation flexible-ethernet-services;
  vlan-tagging;
  unit 1 {
    encapsulation vlan-vpls;
    vlan-id 2000;
  }
}
ge-0/0/0 {
  unit 0 {
    family inet {
      address 10.200.1.1/24;
    }
    family mpls;
  }
}
lo0 {
  unit 0 {
```

```
        family inet {
            address 10.255.168.231/32 {
                primary;
            }
            address 127.0.0.1/32;
        }
    }
}

[edit routing-instances]
vpls-vlan2000 {
    instance-type vpls;
    vlan-id 2000;
    interface ge-1/0/7.1;
    route-distinguisher 10.255.168.231:2000;
    vrf-target target:1000:1;
    protocols {
        vpls {
            site-range 10;
            site vlan2000-PE1 {
                site-identifier 2;
            }
        }
    }
}

[edit protocols]
rsvp {
    interface ge-0/0/0.0;
}
mpls {
    label-switched-path PE1-to-PE2 {
        to 10.100.1.1;
    }
    interface ge-0/0/0.0;
}
bgp {
    group PE1-to-PE2 {
        type internal;
        local-address 10.200.1.1;
        family l2vpn {
            signaling;
        }
        local-as 65000;
        neighbor 10.100.1.1;
    }
}
ospf {
    traffic-engineering;
    reference-bandwidth 4g;
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
}
```

```

        interface ge-0/0/0.0;
    }
}
oam {
    ethernet {
        connectivity-fault-management {
            maintenance-domain customer-site1 {
                level 5;
                maintenance-association customer-site1 {
                    continuity-check {
                        interval 1s;
                    }
                    mep 100 {
                        interface ge-1/0/7.1;
                        direction up;
                        auto-discovery;
                    }
                }
            }
        }
    }
}
}

```

**Configuration of PE2**

```

[edit chassis]
fpc 5 {
    pic 0 {
        tunnel-services {
            bandwidth 1g;
        }
    }
}

[edit interfaces]
ge-5/0/9 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
        encapsulation vlan-vpls;
        vlan-id 2000;
    }
}
ge-5/2/7 {
    unit 0 {
        family inet {
            address 10.100.1.1/24;
        }
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.255.168.230/32 {
                primary;
            }
        }
    }
}

```

```
        address 127.0.0.1/32;
    }
}

[edit routing-instances]
vpls-vlan2000 {
    instance-type vpls;
    vlan-id 2000;
    interface ge-5/0/9.1;
    route-distinguisher 10.255.168.230:2000;
    vrf-target target:1000:1;
    protocols {
        vpls {
            site-range 10;
            site vlan2000-PE2 {
                site-identifier 1;
            }
        }
    }
}

[edit protocols]
rsvp {
    interface ge-5/2/7.0;
}
mpls {
    label-switched-path PE2-to-PE1 {
        to 10.200.1.1;
    }
    interface ge-5/2/7.0;
}
bgp {
    group PE2-to-PE1 {
        type internal;
        local-address 10.100.1.1;
        family l2vpn {
            signaling;
        }
        local-as 65000;
        neighbor 10.200.1.1;
    }
}
ospf {
    traffic-engineering;
    reference-bandwidth 4g;
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
        interface ge-5/2/7.0;
    }
}
oam {
```



```

ethernet {
  connectivity-fault-management {
    maintenance-domain customer-site1 {
      level 5;
      maintenance-association customer-site1 {
        continuity-check {
          interval 1s;
        }
        mep 200 {
          interface ge-5/0/9.1;
          direction up;
          auto-discovery;
        }
      }
    }
  }
}

```

#### Configuration of P router

MPLS only, no CFM needed:

```

[edit]
interfaces {
  ge-5/2/7 {
    # Connected to PE1
    unit 0 {
      family inet {
        address 10.200.1.10/24;
      }
      family mpls;
    }
  }
  ge-0/1/0 {
    # Connected to PE2
    unit 0 {
      family inet {
        address 10.100.1.10/24;
      }
      family mpls;
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.255.168.240/32;
      }
    }
  }
}

[edit]
protocols {
  rsvp {
    interface ge-0/1/0.0;
    interface ge-5/2/7.0;
  }
}

```

```
}
mpls {
  interface ge-0/1/0.0;
  interface ge-5/2/7.0;
}
ospf {
  traffic-engineering;
  reference-bandwidth 4g;
  area 0.0.0.0 {
    interface all;
    interface fxp0.0 {
      disable;
    }
    interface ge-0/1/0.0;
    interface ge-5/2/7.0;
  }
}
}
```

**CFM on L2-CE1** Here is the configuration of CFM on L2-E1:

```
[edit interfaces]
ge-5/2/3 {
  vlan-tagging;
  unit 0 {
    vlan-id 2000;
  }
}

[edit protocols oam]
ethernet {
  connectivity-fault-management {
    maintenance-domain customer {
      level 7;
      maintenance-association customer-site1 {
        continuity-check {
          interval 1s;
        }
        mep 800 {
          interface ge-5/2/3.0;
          direction down;
          auto-discovery;
        }
      }
    }
  }
}
}
```

**CFM on L2-CE2** Here is the configuration of CFM L2-CE2:

```
[edit interfaces]
ge-0/2/9 {
  vlan-tagging;
  unit 0 {
    vlan-id 2000;
```

```

    }
  }

[edit protocols oam]
ethernet {
  connectivity-fault-management {
    maintenance-domain customer {
      level 7;
      maintenance-association customer-site1 {
        continuity-check {
          interval 1s;
        }
        mep 700 {
          interface ge-0/2/9.0;
          direction down;
          auto-discovery;
        }
      }
    }
  }
}

```

**Related  
Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Ethernet Operations, Administration, and Maintenance on page 518](#)
- *Ethernet OAM Connectivity Fault Management*
- [Example: Configuring Ethernet CFM on Bridge Connections on page 580](#)
- [Example: Configuring Ethernet CFM on Physical Interfaces on page 577](#)



# Configuring IEEE 802.3ah OAM Link-Fault Management

- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Configuring Ethernet 802.3ah OAM on PTX Series Packet Transport Routers on page 596](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- [Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 613](#)
- [Example: Configuring Ethernet LFM for CCC on page 615](#)
- [Example: Configuring Ethernet LFM for Aggregated Ethernet on page 616](#)
- [Example: Configuring Ethernet LFM with Loopback Support on page 618](#)

## IEEE 802.3ah OAM Link-Fault Management Overview

---

Ethernet interfaces capable of running at 100 Mbps or faster on EX Series switches, MX Series, M Series (except M5 and M10 routers), and T Series routers support the IEEE 802.3ah standard for Operation, Administration, and Management (OAM). You can configure IEEE 802.3ah OAM on Ethernet point-to-point direct links or links across Ethernet repeaters. The IEEE 802.3ah standard meets the requirement for OAM capabilities as Ethernet moves from being solely an enterprise technology to being a WAN and access technology, as well as being backward-compatible with existing Ethernet technology. Junos OS supports IEEE 802.3ah link-fault management.

The features of link-fault management are:

- Discovery
- Link monitoring
- Remote fault detection
- Remote loopback

The following features are not supported:

- Ethernet running on top of a Layer 2 protocol, such as Ethernet over ATM, is not supported in OAM configurations.
- Remote loopback is not supported on the 10-Gigabit Ethernet LAN/WAN PIC with SFP+.
- The remote loopback feature mentioned in section 57.2.11 of IEEE 802.3ah is not supported on T4000 routers.



**NOTE:** Aggregated Ethernet member links will now use the physical MAC address as the source MAC address in 802.3ah OAM packets.

---

### Related Documentation

- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)

- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring IEEE 802.3ah OAM Link-Fault Management

---

You can configure threshold values for fault events that trigger the sending of link event TLVs when the values exceed the threshold. To set threshold values for fault events on an interface, include the **event-thresholds** statement at the **[edit protocols oam ethernet link-fault-management interface]** hierarchy level.

You can also configure OAM threshold values within an action profile and apply the action profile to multiple interfaces. To create an action profile, include the **action-profile** statement at the **[edit protocols oam ethernet link-fault-management]** hierarchy level.

You can configure Ethernet OAM either on an aggregate interface or on each of its member links. However, we recommend that you configure Ethernet OAM on the aggregate interface, and this will internally enable Ethernet OAM on the member links.

To view OAM statistics, use the **show oam ethernet link-fault-management** operational mode command. To clear OAM statistics, use the **clear oam ethernet link-fault-management statistics** operational mode command. To clear link-fault management state information and restart the link discovery process on Ethernet interfaces, use the **clear oam ethernet link-fault-management state** operational mode command. For more information about these commands, see the [CLI Explorer](#).

### Related Documentation

- [event-thresholds on page 959](#)
- [action-profile on page 859](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)

- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Configuring Ethernet 802.3ah OAM on PTX Series Packet Transport Routers

The IEEE 802.3ah standard for Operation, Administration, and Management (OAM) provides a specification for *Ethernet in the first mile (EFM)* connectivity. EFM defines how Ethernet can be transmitted over new media types using new Ethernet physical layer (PHY) interfaces. You can configure IEEE 802.3ah OAM on Ethernet point-to-point direct links or links across Ethernet repeaters. The IEEE 802.3ah OAM standard meets the requirement for OAM capabilities as Ethernet moves from being solely an enterprise technology to being a WAN and access technology, as well as being backward-compatible with existing Ethernet technology.

For Ethernet interfaces capable of running at 100 Mbps or faster, the IEEE 802.3ah OAM standard is supported on numerous Juniper Networks routers and switches. This topic describes configuration support for IEEE 802.3ah OAM features on PTX Series Packet Transport Routers.

On PTX Series Packet Transport Routers, Junos OS Release 12.1 supports the following IEEE 802.3ah OAM features at the physical interface level:

- Discovery and link monitoring
- Fault signaling and detection
- Periodic packet management (PPM) processing
- Action profile support
- Graceful Routing Engine switchover (GRES)



**NOTE:** OAM is not supported on PTX1000 routers.

---

To configure 802.3ah OAM support for Ethernet interfaces, include the **oam** statement at the **[edit protocols]** hierarchy level:



```

oam {
  ethernet {
    link-fault-management {
      interfaces {
        interface-name {
          pdu-interval interval;
          link-discovery (active | passive);
          pdu-threshold count;
        }
      }
    }
  }
}

```

#### Related Documentation

- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Configuring Link Discovery on page 598](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)

## Enabling IEEE 802.3ah OAM Support

To enable IEEE 802.3ah OAM support, include the **interface** statement at the **[edit protocols oam ethernet link-fault-management]** hierarchy level:

```
[edit protocols oam ethernet link-fault-management interface interface-name]
```

When you enable IEEE 802.3ah OAM on a physical interface, the discovery process is automatically triggered.

#### Related Documentation

- [link-fault-management on page 1025](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)

- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Configuring Link Discovery

When the IEEE 802.3ah OAM protocol is enabled on a physical interface, the discovery process is automatically triggered. The discovery process permits Ethernet interfaces to discover and monitor the peer on the link if it also supports the IEEE 802.3ah standard.

You can specify the discovery mode used for IEEE 802.3ah OAM support. The discovery process is triggered automatically when OAM IEEE 802.3ah functionality is enabled on a port. Link monitoring is done when the interface sends periodic OAM PDUs.

To configure the discovery mode, include the **link-discovery** statement at the **[edit protocol oam ethernet link-fault-management interface *interface-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]  
link-discovery (active | passive);
```

In active mode, the interface discovers and monitors the peer on the link if the peer also supports IEEE 802.3ah OAM functionality. In passive mode, the peer initiates the discovery process. After the discovery process has been initiated, both sides participate in discovery.

### Related Documentation

- [link-discovery on page 1023](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)

- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the OAM PDU Interval

---

Periodic OAM PDUs are sent to perform link monitoring.

You can specify the periodic OAM PDU sending interval for fault detection.

To configure the sending interval, include the **pdu-interval** statement at the **[edit protocol oam ethernet link-fault-management interface *interface-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]  
  pdu-interval interval;
```

The periodic OAM PDU interval range is from 100 through 1000 milliseconds. The default sending interval is 1000 milliseconds.

### Related Documentation

- [pdu-interval on page 1108](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring the OAM PDU Threshold

---

You can specify the number of OAM PDUs that an interface can miss before the link between peers is considered down.

To configure the number of PDUs that can be missed from the peer, include the **pdu-threshold** statement at the **[edit protocol oam ethernet link-fault-management interface *interface-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]  
  pdu-threshold threshold-value;
```

The threshold value range is from 3 through 10. The default is three PDUs.

### Related Documentation

- [pdu-threshold on page 1109](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Threshold Values for Local Fault Events on an Interface

---

You can configure threshold values on an interface for the local errors that trigger the sending of link event TLVs.

To set the error threshold values for sending event TLVs, include the **frame-error**, **frame-period**, **frame-period-summary**, and **symbol-period** statements at the `[edit protocols oam ethernet link-fault-management interface interface-name event-thresholds]` hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
event-thresholds {
  frame-error count;
  frame-period count;
  frame-period-summary count;
  symbol-period count;
}
```

#### Related Documentation

- [event-thresholds on page 959](#)
- [frame-error on page 976](#)
- [frame-period on page 977](#)
- [frame-period-summary on page 978](#)
- [symbol-period on page 1196](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Disabling the Sending of Link Event TLVs

---

You can disable the sending of link event TLVs.

To disable the monitoring and sending of PDUs containing link event TLVs in periodic PDUs, include the **no-allow-link-events** statement at the **[edit protocols oam ethernet link-fault-management interface *interface-name* negotiation-options]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name
 negotiation-options]
no-allow-link-events;
```

### Related Documentation

- [no-allow-link-events on page 1080](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Detecting Remote Faults

---

Fault detection is either based on flags or fault event type, length, and values (TLVs) received in OAM protocol data units (PDUs). Flags that trigger a link fault are:

- Critical Event
- Dying Gasp

- Link Fault

The link event TLVs are sent by the remote DTE by means of event notification PDUs. Link event TLVs are:

- Errored Symbol Period Event
- Errored Frame Event
- Errored Frame Period Event
- Errored Frame Seconds Summary Event

#### Related Documentation

- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring an OAM Action Profile

You can create an action profile to define event fault flags and thresholds and the action to be taken. You can then apply the action profile to one or more interfaces.

To configure an action profile, include the **action-profile** statement at the **[edit protocols oam ethernet link-fault-management]** hierarchy level:

```
action-profile profile-name {  
  action {  
    syslog;
```

```
    link-down;  
    send-critical-event;  
  }  
  event {  
    link-adjacency-loss;  
    link-event-rate {  
      frame-error count;  
      frame-period count;  
      frame-period-summary count;  
      symbol-period count;  
    }  
    protocol-down;  
  }  
}
```



**NOTE:** Whenever link-fault management (LFM) with an action profile is configured to mark the interface as down (by including the link-down statement at the [edit protocols oam ethernet link-fault-management] hierarchy level), the port is placed in the blocked state (STP state). In such a state of the interface, data traffic is not transmitted out on that interface. Because the connectivity-fault management (CFM) downstream maintenance MEPs come up on blocked ports, the CFM sessions come up properly. However, the interface is down and the interface status TLV does not contain the correct status. Only if you configure the port status TLV, the actual status of the port is reflected. The interface status TLV does not carry the actual state of the port.

**Related  
Documentation**

- [action-profile on page 860](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)



- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Specifying the Actions to Be Taken for Link-Fault Management Events

You can specify the action to be taken by the system when the configured link-fault event occurs. Multiple action profiles can be applied to a single interface. For each action-profile, at least one event and one action must be specified. The actions are taken only when all of the events in the action profile are true. If more than one action is specified, all the actions are executed.

You might want to set a lower threshold for a specific action such as logging the error and set a higher threshold for another action such as sending a critical event TLV.

To specify the action, include the **action** statement at the **[edit protocols oam ethernet link-fault-management action-profile *profile-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management action-profile profile-name]
event {
    link-adjacency-loss;
    protocol-down;
}
action {
    syslog;
    link-down;
    send-critical-event;
}
```

To create a system log entry when the link-fault event occurs, include the **syslog** statement.

To administratively disable the link when the link-fault event occurs, include the **link-down** statement.

To send IEEE 802.3ah link event TLVs in the OAM PDU when a link-fault event occurs, include the **send-critical-event** statement.



**NOTE:** If multiple actions are specified in the action profile, all of the actions are executed in no particular order.

### Related Documentation

- [action on page 857](#)
- [syslog on page 1196](#)
- [link-down on page 1024](#)
- [send-critical-event on page 1167](#)

- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Monitoring the Loss of Link Adjacency

You can specify actions be taken when link adjacency is lost. When link adjacency is lost, the system takes the action defined in the **action** statement of the action profile.

To configure the system to take action when link adjacency is lost, include the **link-adjacency-loss** statement at the **[edit protocols oam ethernet link-fault-management action-profile *profile-name* event]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management action-profile profile-name]  
link-adjacency-loss;
```

### Related Documentation

- [link-adjacency-loss on page 1023](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)

- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Monitoring Protocol Status

The CCC-DOWN flag is associated with a circuit cross-connect (CCC) connection, Layer 2 circuit, and Layer 2 VPN, which send the CCC-DOWN status to the kernel. The CCC-DOWN flag indicates that the CCC is down. The CCC-DOWN status is sent to the kernel when the CCC connection, Layer 2 circuit, or Layer 2 VPN is down. This in turn, brings down the CE-facing PE interface associated with the CCC connection, Layer 2 circuit, or Layer 2 VPN.

When the CCC-DOWN flag is signaled to the IEEE 802.3ah protocol, the system takes the action defined in the **action** statement of the action profile. For additional information about Layer 2 circuits, see the Junos OS Layer 2 Circuits Feature Guide, Junos OS VPNs Configuration Guide.

To monitor the IEEE 802.3ah protocol, on the CE-facing PE interface, include the **protocol-down** statement at the **[edit protocols oam ethernet link-fault-management action-profile *profile-name* event]** hierarchy level:

1. In configuration mode, go to the **[edit protocols oam ethernet link-fault-management action-profile *profile-name* event]** hierarchy level.

```
[edit]
user@host# edit protocols oam ethernet link-fault-management action-profile
profile-name event
```

2. Include the **protocol-down** statement.

```
[edit protocols oam ethernet link-fault-management action-profile profile-name event]
user@host# set protocol-down
```



**NOTE:** If multiple events are specified in the action profile, all the events must occur before the specified action is taken.

---

**Related  
Documentation**

- [protocol-down on page 1137](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Configuring Threshold Values for Fault Events in an Action Profile

---

You can configure link event thresholds for received error events that trigger the action specified in the **action** statement. You can then apply the action profile to one or more interfaces.

To configure link event thresholds, include the **link-event-rate** statement at the **[edit protocols oam ethernet link-fault-management action-profile *profile-name* event]** hierarchy level:

```
link-event-rate {  
    frame-error count;  
    frame-period count;  
    frame-period-summary count;  
    symbol-period count;  
}
```

- Related Documentation**
- [link-event-rate on page 1024](#)
  - [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
  - [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
  - [Enabling IEEE 802.3ah OAM Support on page 597](#)
  - [Configuring Link Discovery on page 598](#)
  - [Configuring the OAM PDU Interval on page 599](#)
  - [Configuring the OAM PDU Threshold on page 600](#)
  - [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
  - [Disabling the Sending of Link Event TLVs on page 602](#)
  - [Detecting Remote Faults on page 602](#)
  - [Configuring an OAM Action Profile on page 603](#)
  - [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
  - [Monitoring the Loss of Link Adjacency on page 606](#)
  - [Monitoring Protocol Status on page 607](#)
  - [Applying an Action Profile on page 609](#)
  - [Setting a Remote Interface into Loopback Mode on page 610](#)
  - [Enabling Remote Loopback Support on the Local Interface on page 611](#)
  - [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Applying an Action Profile

You can apply an action profile to one or more interfaces.

To apply an action profile to an interface, include the **apply-action-profile** statement at the **[edit protocols oam ethernet link-fault-management action-profile interface *interface-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]  
  apply-action-profile profile-name;
```

- Related Documentation**
- [apply-action-profile on page 876](#)
  - [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
  - [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
  - [Enabling IEEE 802.3ah OAM Support on page 597](#)
  - [Configuring Link Discovery on page 598](#)
  - [Configuring the OAM PDU Interval on page 599](#)

- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

---

## Setting a Remote Interface into Loopback Mode

You can configure the software to set the remote DTE into loopback mode on the following interfaces:

- IQ2 and IQ2-E Gigabit Ethernet interfaces
- Ethernet interfaces on the MX Series routers or EX Series switches

Junos OS can place a remote DTE into loopback mode (if remote-loopback mode is supported by the remote DTE). When you place a remote DTE into loopback mode, the interface receives the remote-loopback request and puts the interface into remote-loopback mode. When the interface is in remote-loopback mode, all frames except OAM PDUs are looped back without any changes made to the frames. OAM PDUs continue to be sent to the management plane and processed.

To configure remote loopback, include the **remote-loopback** statement at the **[edit protocol oam ethernet link-fault-management interface *interface-name*]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]  
  remote-loopback;
```

To take the remote DTE out of loopback mode, remove the **remote-loopback** statement from the configuration.

### Related Documentation

- [remote-loopback on page 1152](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)

- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Enabling Remote Loopback Support on the Local Interface

You can allow a remote DTE to set a local interface into remote loopback mode on IQ2 and IQ2-E Gigabit Ethernet interfaces and all Ethernet interfaces on the MX Series routers and EX Series switches. When a remote-loopback request is sent by a remote DTE, the Junos OS places the local interface into loopback mode. When an interface is in loopback mode, all frames except OAM PDUs are looped back without any changes to the frames. OAM PDUs continue to be sent to the management plane and processed. By default, the remote loopback feature is not enabled.

To enable remote loopback, include the **allow-remote-loopback** statement at the **[edit protocol oam ethernet link-fault-management interface *interface-name* negotiation-options]** hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name
 negotiation-options]
allow-remote-loopback;
```



**NOTE:** Activation of OAM remote loopback may result in data frame loss.

### Related Documentation

- [allow-remote-loopback on page 875](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)

- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 612](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Example: Configuring IEEE 802.3ah OAM Support on an Interface

---

Configure 802.3ah OAM support on a 10-Gigabit Ethernet interface:

```
[edit]
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface xe-0/0/0 {
          link-discovery active;
          pdu-interval 800;
          pdu-threshold 4;
          remote-loopback;
          negotiation-options {
            allow-remote-loopback;
          }
          event-thresholds {
            frame-error 30;
            frame-period 50;
            frame-period summary 40;
            symbol-period 20;
          }
        }
      }
    }
  }
}
```



}

**Related Documentation**

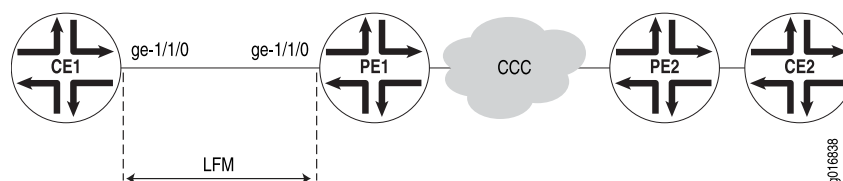
- [link-fault-management on page 1025](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 594](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 595](#)
- [Enabling IEEE 802.3ah OAM Support on page 597](#)
- [Configuring Link Discovery on page 598](#)
- [Configuring the OAM PDU Interval on page 599](#)
- [Configuring the OAM PDU Threshold on page 600](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 600](#)
- [Disabling the Sending of Link Event TLVs on page 602](#)
- [Detecting Remote Faults on page 602](#)
- [Configuring an OAM Action Profile on page 603](#)
- [Specifying the Actions to Be Taken for Link-Fault Management Events on page 605](#)
- [Monitoring the Loss of Link Adjacency on page 606](#)
- [Monitoring Protocol Status on page 607](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 608](#)
- [Applying an Action Profile on page 609](#)
- [Setting a Remote Interface into Loopback Mode on page 610](#)
- [Enabling Remote Loopback Support on the Local Interface on page 611](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

**Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge**

In this example, LFM is enabled on an IP link between the provider edge (PE) and customer edge (CE) interfaces. If the link goes down, the fault will be detected by LFM and the interfaces on both sides will be marked **Link-Layer-Down**. This results in notifications to various subsystems (for example, routing) which will take appropriate action.

The link running LFM is shown in [Figure 43 on page 613](#).

**Figure 43: Ethernet LFM Between Provider Edge and Customer Edge**



To configure Ethernet LFM on an IP link between PE and CE interfaces:

1. Configure LFM on the PE router:

```
[edit]
interfaces ge-1/1/0 {
  unit 0 {
    family inet {
      address 11.11.11.1/24;
    }
  }
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/1/0 {
          pdu-interval 1000;
          pdu-threshold 5;
        }
      }
    }
  }
}
```

2. Configure LFM on the CE router:

```
[edit]
interfaces ge-1/1/0 {
  unit 0 {
    family inet {
      address 11.11.11.2/24;
    }
  }
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/1/0 {
          pdu-interval 1000;
          pdu-threshold 5;
        }
      }
    }
  }
}
```

**Related  
Documentation**

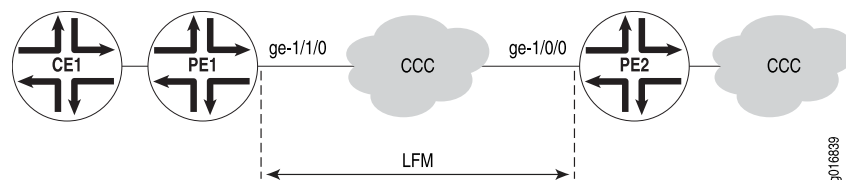
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet OAM Link Fault Management*
- [Example: Configuring Ethernet LFM for CCC on page 615](#)
- [Example: Configuring Ethernet LFM for Aggregated Ethernet on page 616](#)
- [Example: Configuring Ethernet LFM with Loopback Support on page 618](#)

## Example: Configuring Ethernet LFM for CCC

In this example, LFM is configured between two PEs (PE1 and PE2) connected using CCC. With LFM in place, a link fault will be detected immediately, instead of depending on routing protocols to find the fault on end-to-end CCC connection. This also helps in detecting the exact failed link instead of only finding that the end-to-end CCC connectivity has failed. Also, because LFM runs at the link-layer level, it does not need a IP address to operate and so can be used where bidirectional fault detection (BFD) cannot.

The links running LFM are shown in [Figure 44 on page 615](#)

**Figure 44: Ethernet LFM for CCC**



To configure Ethernet LFM between two PEs connected using CCC:

1. Configure LFM on the PE1 router with CCC:

```
[edit]
interfaces ge-1/1/0 {
  encapsulation ethernet-ccc;
  unit 0;
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/1/0 {
          pdu-interval 1000;
          pdu-threshold 5;
        }
      }
    }
  }
}
```

2. Configure LFM on the PE2 router with CCC:

```
[edit]
interfaces ge-1/0/0 {
  encapsulation ethernet-ccc;
  unit 0;
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/0/0 {
          pdu-interval 1000;
        }
      }
    }
  }
}
```

```

        pdu-threshold 5;
    }
}
}
}
}

```

#### Related Documentation

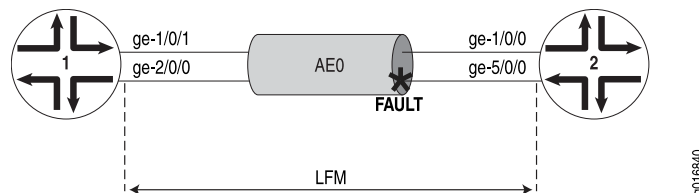
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet OAM Link Fault Management*
- [Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 613](#)
- [Example: Configuring Ethernet LFM for Aggregated Ethernet on page 616](#)
- [Example: Configuring Ethernet LFM with Loopback Support on page 618](#)

## Example: Configuring Ethernet LFM for Aggregated Ethernet

In this example, LFM is configured on an aggregated Ethernet interface (AE0) between Router 1 and Router 2. When configured on aggregated Ethernet, LFM runs on all the individual member links. LFM is enabled or disabled on the member links as they are added or deleted from the aggregation group. The status of individual links is used to determine the status of the aggregated interface.

The use of LFM with aggregated Ethernet is shown in [Figure 45 on page 616](#).

**Figure 45: Ethernet LFM for Aggregated Ethernet**



To configure LFM on an aggregated Ethernet interface between two routers:

1. Configure LFM on Router 1 for AE0:

```

[edit]
chassis {
  aggregated-devices {
    ethernet {
      device-count 1;
    }
  }
}
interfaces ge-1/0/1 {
  gigether-options {
    802.3ad ae0;
  }
}
interfaces ge-2/0/0 {

```

```

    gigether-options {
        802.3ad ae0;
    }
}
interfaces ae0 {
    unit 0 {
        family inet {
            address 11.11.11.2/24;
        }
    }
}
protocols {
    oam {
        ethernet {
            link-fault-management {
                interface ae0;
            }
        }
    }
}

```

2. Configure LFM on Router 2 for AE0:

```

[edit]
chassis {
    aggregated-devices {
        ethernet {
            device-count 1;
        }
    }
}
interfaces ge-1/0/0 {
    gigether-options {
        802.3ad ae0;
    }
}
interfaces ge-5/0/0 {
    gigether-options {
        802.3ad ae0;
    }
}
interfaces ae0 {
    unit 0 {
        family inet {
            address 11.11.11.1/24;
        }
    }
}
protocols {
    oam {
        ethernet {
            link-fault-management {
                interface ae0;
            }
        }
    }
}

```

}

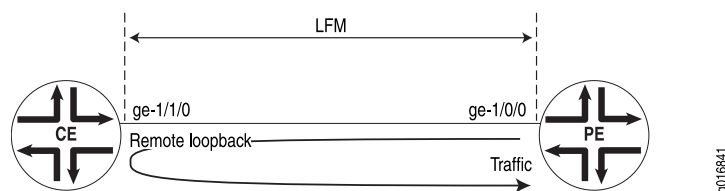
**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet OAM Link Fault Management*
- [Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 613](#)
- [Example: Configuring Ethernet LFM for CCC on page 615](#)
- [Example: Configuring Ethernet LFM with Loopback Support on page 618](#)

## Example: Configuring Ethernet LFM with Loopback Support

In this example, LFM is configured between provider edge (PE) router and the customer edge (CE) router. The PE router can put the CE router in remote loopback mode. This allows the PE to have all the traffic sent to the CE router looped back for diagnostics purposes, as shown in [Figure 46 on page 618](#).

**Figure 46: Ethernet LFM with Loopback Support**



To configure LFM between a PE router and a CE router:

1. Configure LFM loopback on the PE router:

```
[edit]
interfaces ge-1/0/0 {
  unit 0 {
    family inet {
      address 11.11.11.1/24;
    }
  }
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/0/0 {
          pdu-interval 1000;
          pdu-threshold 5;
          remote-loopback;
        }
      }
    }
  }
}
```

## 2. Configure LFM loopback on the CE router:

```
[edit]
interfaces ge-1/1/0 {
  unit 0 {
    family inet {
      address 11.11.11.2/24;
    }
  }
}
protocols {
  oam {
    ethernet {
      link-fault-management {
        interface ge-1/1/0 {
          pdu-interval 1000;
          pdu-threshold 5;
          negotiation-options {
            allow-remote-loopback;
          }
        }
      }
    }
  }
}
```



**NOTE:** If the negotiation options `allow-remote-loopback` statement on the CE router is deleted before removing the CE router from remote loopback mode, traffic flow between the PE router and CE router is affected. Hence, delete the `remote-loopback` statement on the PE router before deleting the `negotiation-options allow-remote-loopback` statement on the CE router.

**Related  
Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet OAM Link Fault Management*
- [Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 613](#)
- [Example: Configuring Ethernet LFM for CCC on page 615](#)
- [Example: Configuring Ethernet LFM for Aggregated Ethernet on page 616](#)





## CHAPTER 33

# Configuring ITU-T Y.1731 Ethernet Service OAM

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Service-Level Agreement Measurement on page 630](#)
- [On-Demand Mode for SLA Measurement on page 631](#)
- [Proactive Mode for SLA Measurement on page 632](#)
- [Ethernet Failure Notification Protocol Overview on page 633](#)
- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Format of ETH-SLM Messages on page 637](#)
- [Transmission of ETH-SLM Messages on page 639](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- [Configuring an Iterator Profile on page 652](#)
- [Verifying the Configuration of an Iterator Profile on page 654](#)
- [Managing Iterator Statistics on page 657](#)
- [Configuring a Remote MEP with an Iterator Profile on page 662](#)
- [Configuring Statistical Frame Loss Measurement for VPLS Connections on page 663](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- [Guidelines for Starting an ETH-DM Session on page 665](#)
- [Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 667](#)
- [Configuring Routers to Support an ETH-DM Session on page 671](#)
- [Starting an ETH-DM Session on page 675](#)
- [Starting a One-Way ETH-DM Session on page 678](#)

- [Starting a Two-Way ETH-DM Session on page 678](#)
- [Managing ETH-DM Statistics and ETH-DM Frame Counts on page 679](#)
- [Displaying ETH-DM Statistics Only on page 681](#)
- [Displaying ETH-DM Statistics and Frame Counts on page 682](#)
- [Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity on page 682](#)
- [Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level on page 683](#)
- [Clearing ETH-DM Statistics and Frame Counts on page 684](#)
- [Configuring MEP Interfaces on page 684](#)
- [Ensuring That Distributed ppm Is Not Disabled on page 685](#)
- [Enabling the Hardware-Assisted Timestamping Option on page 687](#)
- [Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling on page 688](#)
- [Using the monitor ethernet delay-measurement Command on page 689](#)
- [Managing ETH-LM Statistics on page 690](#)
- [Managing Continuity Measurement Statistics on page 691](#)
- [Configuring the Failure Notification Protocol on page 692](#)
- [Ethernet Alarm Indication Signal \(ETH-AIS\) Function Overview on page 693](#)
- [Configuring ETH-AIS on a CFM MEP on page 696](#)
- [Example: Configuring One-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces on page 700](#)
- [Example: Configuring Two-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces on page 705](#)
- [Example: Configuring Ethernet Frame Delay Measurements with Untagged Interfaces on page 709](#)
- [Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs on page 711](#)
- [Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs on page 722](#)
- [Triggering an Ethernet Frame Delay Measurements Session on page 734](#)
- [Viewing Ethernet Frame Delay Measurements Statistics on page 735](#)

---

## Ethernet Frame Delay Measurements Overview

- [ITU-T Y.1731 Frame Delay Measurement Feature on page 623](#)
- [One-Way Ethernet Frame Delay Measurement on page 624](#)
- [Two-Way Ethernet Frame Delay Measurement on page 626](#)
- [Choosing Between One-Way and Two-Way ETH-DM on page 627](#)
- [Restrictions for Ethernet Frame Delay Measurement on page 627](#)

## ITU-T Y.1731 Frame Delay Measurement Feature

The IEEE 802.3-2005 standard for Ethernet Operations, Administration, and Maintenance (OAM) defines a set of link fault management mechanisms to detect and report link faults on a single point-to-point Ethernet LAN.

Junos OS supports key OAM standards that provide for automated end-to-end management and monitoring of Ethernet service by service providers:

- *IEEE Standard 802.1ag*, also known as “Connectivity Fault Management (CFM).”
- *ITU-T Recommendation Y.1731*, which uses different terminology than IEEE 802.1ag and defines Ethernet service OAM features for fault monitoring, diagnostics, and performance monitoring.

These capabilities allow operators to offer binding service-level agreements (SLAs) and generate new revenues from rate- and performance-guaranteed service packages that are tailored to the specific needs of their customers.

### Ethernet CFM

The IEEE 802.1ag standard for connectivity fault management (CFM) defines mechanisms to provide for end-to-end Ethernet service assurance over any path, whether a single link or multiple links spanning networks composed of multiple LANs.

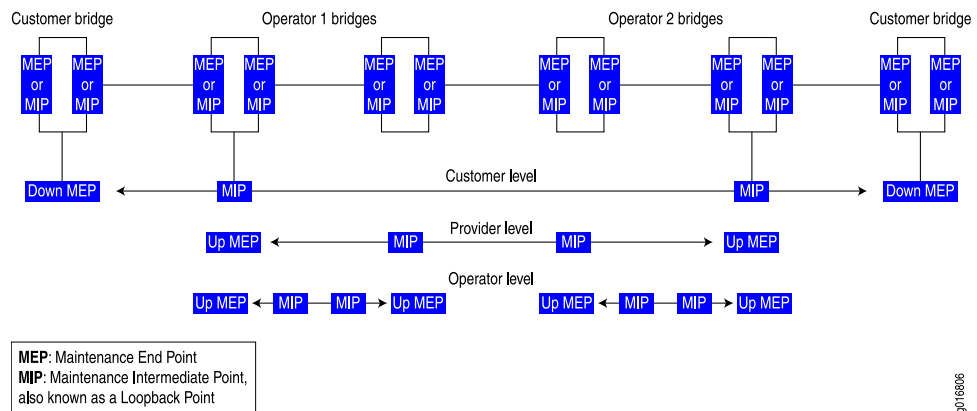
For Ethernet interfaces on M320, MX Series, and T Series routers, Junos OS supports the following key elements of the Ethernet CFM standard:

- Fault monitoring using the IEEE 802.1ag Ethernet OAM Continuity Check protocol
- Path discovery and fault verification using the IEEE 802.1ag Ethernet OAM Linktrace protocol
- Fault isolation using the IEEE 802.1ag Ethernet OAM Loopback protocol

In a CFM environment, network entities such as network operators, service providers, and customers may be part of different administrative domains. Each administrative domain is mapped into one maintenance domain. Maintenance domains are configured with different level values to keep them separate. Each domain provides enough information for the entities to perform their own management and end-to-end monitoring, and still avoid security breaches.

[Figure 47 on page 624](#) shows the relationships among the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

Figure 47: Relationship of MEPs, MIPs, and Maintenance Domain Levels



**NOTE:** Maintenance intermediate points (MIP) are not supported on the ACX Series routers.

## Ethernet Frame Delay Measurement

Two key objectives of OAM functionality are to measure quality-of-service attributes such as frame delay and frame delay variation (also known as "frame jitter"). Such measurements can enable you to identify network problems before customers are impacted by network defects.

Junos OS supports Ethernet frame delay measurement between MEPs configured on Ethernet physical or logical interfaces on MX Series routers. Ethernet frame delay measurement provides fine control to operators for triggering delay measurement on a given service and can be used to monitor SLAs. Ethernet frame delay measurement also collects other useful information, such as worst and best case delays, average delay, and average delay variation. The Junos OS implementation of Ethernet frame delay measurement (ETH-DM) is fully compliant with the ITU-T Recommendation Y.1731, *OAM Functions and Mechanisms for Ethernet-based Networks*. The recommendation defines OAM mechanisms for operating and maintaining the network at the Ethernet service layer, which is called the "ETH layer" in ITU-T terminology.

MX Series routers with modular port concentrators (MPCs) and 10-Gigabit Ethernet MPCs with SFP+ support ITU-T Y.1731 functionality on VPLS for frame-delay and delay-variation.

## One-Way Ethernet Frame Delay Measurement

In one-way ETH-DM mode, a series of frame delay and frame delay variation values are calculated based on the time elapsed between the time a measurement frame is sent from the initiator MEP at one router and the time when the frame is received at the receiver MEP at the other router.

### 1DM Transmission

When you start a one-way frame delay measurement, the router sends 1DM frames—frames that carry the protocol data unit (PDU) for a one-way delay measurement—from the initiator MEP to the receiver MEP at the rate and for the number of frames you specify. The router marks each 1DM frame as drop-ineligible and inserts a timestamp of the transmission time into the frame.

### 1DM Reception

When an MEP receives a 1DM frame, the router that contains the receiver MEP measures the one-way delay for that frame (the difference between the time the frame was received and the timestamp contained in the frame itself) and the delay variation (the difference between the current and previous delay values).

### One-Way ETH-DM Statistics

The router that contains the receiver MEP stores each set of one-way delay statistics in the ETH-DM database. The ETH-DM database collects up to 100 sets of statistics for any given CFM session (pair of peer MEPs). You can access these statistics at any time by displaying the ETH-DM database contents.

### One-Way ETH-DM Frame Counts

Each router counts the number of one-way ETH-DM frames sent and received:

- For an initiator MEP, the router counts the number of 1DM frames sent.
- For a receiver MEP, the router counts the number of valid 1DM frames received and the number of invalid 1DM frames received.

Each router stores ETH-DM frame counts in the CFM database. The CFM database stores CFM session statistics and, for interfaces that support ETH-DM, any ETH-DM frame counts. You can access the frame counts at any time by displaying CFM database information for Ethernet interfaces assigned to MEPs or for MEPs in CFM sessions.

### Synchronization of System Clocks

The accuracy of one-way delay calculations depends on close synchronization of the system clocks at the initiator MEP and receiver MEP.

The accuracy of one-way delay variation is not dependent on system clock synchronization. Because delay variation is simply the difference between consecutive one-way delay values, the out-of-phase period is eliminated from the frame jitter values.



**NOTE:** For a given one-way Ethernet frame delay measurement, frame delay and frame delay variation values are available only on the router that contains the receiver MEP.

## Two-Way Ethernet Frame Delay Measurement

In two-way ETH-DM mode, frame delay and frame delay variation values are based on the time difference between when the initiator MEP transmits a request frame and receives a reply frame from the responder MEP, subtracting the time elapsed at the responder MEP.

---

### DMM Transmission

When you start a two-way frame delay measurement, the router sends delay measurement message (DMM) frames— frames that carry the PDU for a two-way ETH-DM request—from the initiator MEP to the responder MEP at the rate and for the number of frames you specify. The router marks each DMM frame as drop-ineligible and inserts a timestamp of the transmission time into the frame.

---

### DMR Transmission

When an MEP receives a DMM frame, the responder MEP responds with a delay measurement reply (DMR) frame, which carries ETH-DM reply information and a copy of the timestamp contained in the DMM frame.

---

### DMR Reception

When an MEP receives a valid DMR, the router that contains the MEP measures the two-way delay for that frame based on the following sequence of timestamps:

1.  $TI_{TxDMM}$
2.  $TR_{RxDMM}$
3.  $TR_{TxDMR}$
4.  $TI_{RxDMR}$

A two-way frame delay is calculated as follows:

$$[TI_{RxDMR} - TI_{TxDMM}] - [TR_{TxDMR} - TR_{RxDMM}]$$

The calculation show that frame delay is the difference between the time at which the initiator MEP sends a DMM frame and the time at which the initiator MEP receives the associated DMR frame from the responder MEP, minus the time elapsed at the responder MEP.

The delay variation is the difference between the current and previous delay values.

---

### Two-Way ETH-DM Statistics

The router that contains the initiator MEP stores each set of two-way delay statistics in the ETH-DM database. The ETH-DM database collects up to 100 sets of statistics for any given CFM session (pair of peer MEPs). You can access these statistics at any time by displaying the ETH-DM database contents.

## Two-Way ETH-DM Frame Counts

Each router counts the number of two-way ETH-DM frames sent and received:

- For an initiator MEP, the router counts the number DMM frames transmitted, the number of valid DMR frames received, and the number of invalid DMR frames received.
- For a responder MEP, the router counts the number of DMR frames sent.

Each router stores ETH-DM frame counts in the CFM database. The CFM database stores CFM session statistics and, for interfaces that support ETH-DM, any ETH-DM frame counts. You can access the frame counts at any time by displaying CFM database information for Ethernet interfaces assigned to MEPs or for MEPs in CFM sessions.



**NOTE:** For a given two-way Ethernet frame delay measurement, frame delay and frame delay variation values are available only at the router that contains the initiator MEP.

## Choosing Between One-Way and Two-Way ETH-DM

One-way frame delay measurement requires that the system clocks at the initiator MEP and receiver MEP are closely synchronized. Two-way frame delay measurement does not require synchronization of the two systems. If it is not practical for the clocks to be synchronized, two-way frame delay measurements are more accurate.

When two systems are physically close to each other, their one-way delay values are very high compared to their two-way delay values. One-way delay measurement requires that the timing for the two systems be synchronized at a very granular level, and MX Series routers currently do not support this granular synchronization.

## Restrictions for Ethernet Frame Delay Measurement

The following restrictions apply to the Ethernet frame delay measurement feature:

- The ETH-DM feature is not supported on aggregated Ethernet interfaces or label-switched interface. (LSI) pseudowires.
- Hardware-assisted timestamping for ETH-DM frames in the reception path is only supported for MEP interfaces on Enhanced DPCs and Enhanced Queuing DPCs in MX Series routers. For information about hardware-assisted timestamping, see [“Guidelines for Configuring Routers to Support an ETH-DM Session” on page 664](#) and [“Enabling the Hardware-Assisted Timestamping Option” on page 674](#).
- Ethernet frame delay measurements can be triggered only when the distributed periodic packet management daemon (**ppm**) is enabled. For more information about this limitation, see [“Guidelines for Configuring Routers to Support an ETH-DM Session” on page 664](#) and [“Ensuring That Distributed ppm Is Not Disabled” on page 673](#).
- You can monitor only one session at a time to the same remote MEP or MAC address. For more information about starting an ETH-DM session, see [“Starting an ETH-DM Session” on page 675](#).

- ETH-DM statistics are collected at only one of the two peer routers in the ETH-DM session. For a one-way ETH-DM session, you can display frame ETH-DM statistics at the receiver MEP only, using ETH-DM-specific **show** commands. For a two-way ETH-DM session, you can display frame delay statistics at the initiator MEP only, using the same ETH-DM-specific **show** commands. For more information, see [“Managing ETH-DM Statistics and ETH-DM Frame Counts” on page 679](#).
- ETH-DM frame counts are collected at both MEPs and are stored in the respective CFM databases.
- If graceful Routing Engine switchover (GRES) occurs, any collected ETH-DM statistics are lost, and ETH-DM frame counts are reset to zeroes. Therefore, the collection of ETH-DM statistics and ETH-DM frame counters has to be restarted, after the switchover is complete. GRES enables a router with dual Routing Engines to switch from a master Routing Engine to a backup Routing Engine without interruption to packet forwarding. For more information, see the *Junos OS High Availability Library for Routing Devices*.
- Accuracy of frame delay statistics is compromised when the system is changing (such as from reconfiguration). We recommend performing Ethernet frame delay measurements on a stable system.

**Related Documentation**

- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Example: One-Way Ethernet Frame Delay Measurement](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- [Guidelines for Starting an ETH-DM Session on page 665](#)
- [Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 667](#)
- [On-Demand Mode for SLA Measurement on page 631](#)
- [Proactive Mode for SLA Measurement on page 632](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Ethernet Frame Loss Measurement Overview

The key objectives of the OAM functionality are to measure quality-of-service attributes such as frame delay, frame delay variation (also known as “frame jitter”), and frame loss. Such measurements enable you to identify network problems before customers are impacted by network defects. For more information about Ethernet frame delay measurement, see [“Ethernet Frame Delay Measurements Overview” on page 622](#).

Junos OS supports Ethernet frame loss measurement (ETH-LM) between maintenance association end points (MEPs) configured on Ethernet physical or logical interfaces on MX Series routers and is presently supported only for VPWS service. ETH-LM is used by operators to collect counter values applicable for ingress and egress service frames. These counters maintain a count of transmitted and received data frames between a pair of MEPs. Ethernet frame loss measurement is performed by sending frames with ETH-LM information to a peer MEP and similarly receiving frames with ETH-LM information



from the peer MEP. This type of frame loss measurement is also known as single-ended Ethernet loss measurement.

ETH-LM supports the following frame loss measurements:

- Near-end frame loss measurement—Measurement of frame loss associated with ingress data frames.
- Far-end frame loss measurement—Measurement of frame loss associated with egress data frames.



**NOTE:** The proactive and dual-ended loss measurement functionality of ITU-T Y1731 is not supported on the ACX Series routers.



**NOTE:** The Ethernet loss measurement (ETH-LM) results are inaccurate when connectivity fault management (CFM) and performance monitoring (PM) PDUs received locally at a maintenance endpoint (MEP) as classified as belonging to the yellow class or a packet loss priority (PLP) of medium-high. This problem of incorrect results is specific to Ethernet loss measurement for CFM sessions of down MEPs. The Ethernet loss measurement statistics are inaccurate in the following scenarios:

- Ethernet loss measurement is working on a CFM session for a MEP in down state
- CFM PDUs received on the logical interface of the down MEP are classified by the classifier as yellow or medium-high PLP
- A packet is identified as yellow when the input classifier marks the PLP as medium-high.

The problem of discrepancies with Ethernet loss measurement results is not observed when you configure Ethernet loss measurement in colorless mode. To avoid this problem of inaccurate loss measurement results, provision all local CFM PDUs as green or with the PLP as high.



**NOTE:** Performance monitoring for connectivity fault management (by including the performance-monitoring statement and its substatements at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level) is not supported when the network-to-network (NNI) or egress interface is an aggregated Ethernet interface with member links on DPCs.

#### Related Documentation

- [Managing Continuity Measurement Statistics on page 691](#)
- [On-Demand Mode for SLA Measurement on page 631](#)
- [Proactive Mode for SLA Measurement on page 632](#)

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs on page 711](#)
- [Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs on page 722](#)

## Service-Level Agreement Measurement

---

Service-level agreement (SLA) measurement is the process of monitoring the bandwidth, delay, delay variation (jitter), continuity, and availability of a service (E-Line or E-LAN). It enables you to identify network problems before customers are impacted by network defects.



---

### NOTE:

The Ethernet VPN services can be classified into:

- Peer-to-peer-services (E-Line services)—The E-Line services are offered using MPLS-based Layer 2 VPN virtual private wire service (VPWS).
- Multipoint-to-multipoint services (E-LAN services)—The E-LAN services are offered using MPLS-based virtual private LAN service (VPLS).

For more information, see the *Junos VPNs Configuration Guide*.

---

In Junos OS, SLA measurements are classified into:

- On-demand mode—In on-demand mode, the measurements are triggered through the CLI. For more information, see [“On-Demand Mode for SLA Measurement” on page 631](#).
- Proactive mode—In proactive mode, the measurements are triggered by an iterator application. For more information, see [“Proactive Mode for SLA Measurement” on page 632](#).

For more information about frame delay measurement, see [“Ethernet Frame Delay Measurements Overview” on page 622](#). For more information about frame loss measurement, see [“Ethernet Frame Loss Measurement Overview” on page 628](#). Note that Ethernet frame delay measurement and Ethernet frame loss measurement are not supported on the **ae** interface.

### Related Documentation

- [Proactive Mode for SLA Measurement on page 632](#).
- [On-Demand Mode for SLA Measurement on page 631](#).
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## On-Demand Mode for SLA Measurement

---

In on-demand mode, the measurements are triggered by the user through the CLI.

When the user triggers the delay measurement through the CLI, the delay measurement request that is generated is as per the frame formats specified by the ITU-T Y.1731 standard. For two-way delay measurement, the server-side processing can be delegated to the Packet Forwarding Engine to prevent overloading on the Routing Engine. For more information, see [“Configuring Routers to Support an ETH-DM Session” on page 671](#). When the server-side processing is delegated to the Packet Forwarding Engine, the delay measurement message (DMM) frame **receive** counters and delay measurement reply (DMR) frame **transmit** counters are not displayed by the **show** command.

When the user triggers the loss measurement through the CLI, the router sends the packets in standard format along with the loss measurement TLV. By default, the **session-id-tlv** argument is included in the packet to allow concurrent loss measurement sessions from same local MEP. You can also disable the session ID TLV by using the **no-session-id-tlv** argument.

Single-ended ETH-LM is used for on-demand operation, administration, and maintenance purposes. An MEP sends frames with ETH-LM request information to its peer MEP and receives frames with ETH-LM reply information from its peer MEP to carry out loss measurements. The protocol data unit (PDU) used for a single-ended ETH-LM request is referred to as a loss measurement message (LMM) and the PDU used for a single-ended ETH-LM reply is referred to as a loss measurement reply (LMR).

### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Proactive Mode for SLA Measurement on page 632](#)
- [Configuring Routers to Support an ETH-DM Session on page 671](#).
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Proactive Mode for SLA Measurement

---

In proactive mode, SLA measurements are triggered by an iterator application. An iterator is designed to periodically transmit SLA measurement packets in form of ITU-Y.1731-compliant frames for two-way delay measurement or loss measurement on MX Series routers. This mode differs from on-demand SLA measurement, which is user initiated. The iterator sends periodic delay or loss measurement request packets for each of the connections registered to it. Iterators make sure that measurement cycles do not occur at the same time for the same connection to avoid CPU overload. Junos OS supports proactive mode for VPWS. For an iterator to form a remote adjacency and to become functionally operational, the continuity check message (CCM) must be active between the local and remote MEP configurations of the connectivity fault management (CFM). Any change in the iterator adjacency parameters resets the existing iterator statistics and restarts the iterator. Here, the term adjacency refers to a pairing of two endpoints (either connected directly or virtually) with relevant information for mutual understanding, which is used for subsequent processing. For example, the iterator adjacency refers to the iterator association between the two endpoints of the MEPs.

For every DPC or MPC, only 30 iterator instances for a cycle time value of 10 milliseconds (ms) are supported. In Junos OS, 255 iterator profile configurations and 2000 remote MEP associations are supported.

Iterators with cycle time value less than 100 ms are supported only for infinite iterators, whereas the iterators with cycle time value greater than 100 ms are supported for both finite and infinite iterators. Infinite iterators are iterators that run infinitely until the iterator is disabled or deactivated manually.

A VPWS service configured on a router is monitored for SLA measurements by registering the connection (here, the connection is a pair of remote and local MEPs) on an iterator and then initiating periodic SLA measurement frame transmission on those connections. The end-to-end service is identified through a maintenance association end point (MEP) configured at both ends.

For two-way delay measurement and loss measurement, an iterator sends a request message for the connection in the list (if any) and then sends a request message for the connection that was polled in the former iteration cycle. The back-to-back request messages for the SLA measurement frames and their responses help in computing delay variation and loss measurement.

The Y.1731 frame transmission for a service attached to an iterator continues endlessly unless intervened and stopped by an operator or until the iteration-count condition is met. To stop the iterator from sending out any more proactive SLA measurement frames, the operator must perform one of the following tasks:

- Enable the **deactivate sla-iterator-profile** statement at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name* maintenance association *ma-name* mep *mep-id* remote-mep *mep-id*]** hierarchy level. For more information, see [“Verifying the Configuration of an Iterator Profile” on page 654](#).

- Provision a **disable** statement under the corresponding iterator profile at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles *profile-name*]** hierarchy level. For more information, see [“Configuring an Iterator Profile” on page 652](#).

## Ethernet Delay Measurements and Loss Measurement by Proactive Mode

In two-way delay measurement, the delay measurement message (DMM) frame is triggered through an iterator application. The DMM frame carries an iterator type, length, and value (TLV) in addition to the fields described in standard frame format and the server copies the iterator TLV from the DMM frame to the delay measurement reply (DMR) frame.

In one-way delay variation computation using the two-way delay measurement method, the delay variation computation is based on the timestamps that are present in the DMR frame (and not the IDM frame). Therefore, there is no need for client-side and server-side clocks to be in sync. Assuming that the difference in their clocks remains constant, the one-way delay variation results are expected to be fairly accurate. This method also eliminates the need to send separate IDM frames just for the one-way delay variation measurement purpose.

In proactive mode for loss measurement, the router sends packets in standard format along with loss measurement TLV and iterator TLV.

### Related Documentation

- [Configuring an Iterator Profile on page 652](#)
- [Configuring a Remote MEP with an Iterator Profile on page 662](#)
- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Verifying the Configuration of an Iterator Profile on page 654](#)
- [Managing Iterator Statistics on page 657](#)
- [On-Demand Mode for SLA Measurement on page 631](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Ethernet Failure Notification Protocol Overview

The Failure Notification Protocol (FNP) is a failure notification mechanism that detects failures in Point-to-Point Ethernet transport networks on MX Series routers. If a node link fails, FNP detects the failure and sends out FNP messages to the adjacent nodes that a circuit is down. Upon receiving the FNP message, nodes can redirect traffic to the protection circuit.



**NOTE:** FNP is supported on E-Line services only.

An E-Line service provides a secure Point-to-Point Ethernet connectivity between two user network interfaces (UNIs). E-Line services are a protected service and each service has a working circuit and protection circuit. CFM is used to monitor the working and protect paths. CCM intervals result in failover time in hundreds of milliseconds or a few seconds. FNP provides service circuit failure detection and propagation in less than 50ms and provide 50ms failover for E-Line services.

The MX router acts as a PE node and handles the FNP messages received on the management VLAN and the FNP messages received on both the Ethernet interfaces and PWs created for the management VPLS. MX-series routers do not initiate FNP messages and responds only to FNP messages generated by devices in the Ethernet Access network. FNP can be enabled only on logical interfaces that are part of a VPLS routing instance, and no physical interfaces in that VPLS routing instance should have CCM configured. FNP can be enabled only on one logical interface per physical interface.

All E-Line services are configured as layer 2 circuits with edge protection. A VLAN associated with the working circuit or protection circuit must map to a logical interface. No trunk port or access port is supported in the ring link for VLANs used by E-LINE services. FNP does not control the logical interface associated with protection circuit. Only E-Line service whose termination point is not in an MX node is controlled by FNP.

FNP supports graceful restart and the Graceful Routing Engine switchover (GRES) features.

**Related  
Documentation**

- [Configuring the Failure Notification Protocol on page 692](#)
- [show oam ethernet fnp interface on page 1778](#)
- [show oam ethernet fnp status on page 1781](#)
- [show oam ethernet fnp messages on page 1779](#)
- [connectivity-fault-management on page 914](#)
- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Ethernet Synthetic Loss Measurement Overview

Ethernet synthetic loss measurement (ETH-SLM) is an application that enables the calculation of frame loss by using synthetic frames instead of data traffic. This mechanism can be considered as a statistical sample to approximate the frame loss ratio of data traffic. Each maintenance association end point (MEP) performs frame loss measurements, which contribute to unavailable time.

A near-end frame loss specifies frame loss associated with ingress data frames and a far-end frame loss specifies frame loss associated with egress data frames. Both near-end and far-end frame loss measurements contribute to near-end severely errored seconds and far-end severely errored seconds that are used in combination to determine unavailable time. ETH-SLM is performed using synthetic loss message (SLM) and synthetic loss reply (SLR) frames. ETH-SLM facilitates each MEP to perform near-end and far-end synthetic frame loss measurements by using synthetic frames because a

bidirectional service is defined as unavailable if either of the two directions is determined to be unavailable.

There are the two types of frame loss measurement, defined by the ITU-T Y.1731 standards, ETH-LM and ETH-SLM. Junos OS supports only single-ended ETH-SLM. In single-ended ETH-SLM, each MEP sends frames with the ETH-SLM request information to its peer MEP and receives frames with ETH-SLM reply information from its peer MEP to perform synthetic loss measurements. Single-ended ETH-SLM is used for proactive or on-demand OAM to perform synthetic loss measurements applicable to point-to-point Ethernet connection. This method allows a MEP to initiate and report far-end and near-end loss measurements associated with a pair of MEPs that are part of the same maintenance entity group (MEG).

Single-ended ETH-SLM is used to perform on-demand or proactive tests by initiating a finite amount of ETH-SLM frames to one or multiple MEP peers and receiving the ETH-SLM reply from the peers. The ETH-SLM frames contain the ETH-SLM information that is used to measure and report both near-end and far-end synthetic loss measurements. Service-level agreement (SLA) measurement is the process of monitoring the bandwidth, delay, delay variation (jitter), continuity, and availability of a service. It enables you to identify network problems before customers are impacted by network defects. In proactive mode, SLA measurements are triggered by an iterator application. An iterator is designed to periodically transmit SLA measurement packets in the form of ITU-Y.1731-compliant frames for synthetic frame loss measurement. This mode differs from on-demand SLA measurement, which is user initiated. In on-demand mode, the measurements are triggered by the user through the CLI. When the user triggers the ETH-SLM through the CLI, the SLM request that is generated is as per the frame formats specified by the ITU-T Y.1731 standard.

#### Related Documentation

- [Transmission of ETH-SLM Messages on page 639](#)
- [Format of ETH-SLM Messages on page 637](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Scenarios for Configuration of ETH-SLM

ETH-SLM measures near-end and far-end frame loss between two MEPs that are part of the same MEG level. You can configure ETH-SLM to measure synthetic loss for both upward-facing or upstream MEP and downward-facing or downstream MEP. This section describes the following scenarios for the operation of ETH-SLM:

## Upstream MEP in MPLS Tunnels

Consider a scenario in which a MEP is configured between the user network interfaces (UNIs) of two MX Series routers, MX1 and MX2, in the upstream direction. MX1 and MX2 are connected over an MPLS core network. ETH-SLM measurements are performed between the upstream MEP in the path linking the two routers. Both MX1 and MX2 can initiate on-demand or proactive ETH-SLM, which can measure both far-end and near-end loss at MX1 and MX2, respectively. The two UNIs are connected using MPLS-based Layer 2 VPN virtual private wire service (VPWS).

## Downstream MEP in Ethernet Networks

Consider a scenario in which a MEP is configured between two MX Series routers, MX1 and MX2, on the Ethernet interfaces in the downstream direction. MX1 and MX2 are connected in an Ethernet topology and downstream MEP is configured toward the Ethernet network. ETH-SLM measurements are performed between the downstream MEP in the path linking the two routers. ETH-SLM can be measured in the path between these two routers.

Consider another scenario in which a MEP is configured in the downstream direction and service protection for a VPWS over MPLS is enabled by specifying a working path or protect path on the MEP. Service protection provides end-to-end connection protection of the working path in the event of a failure. To configure service protection, you must create two separate transport paths—a working path and a protect path. You can specify the working path and protect path by creating two maintenance associations. To associate the maintenance association with a path, you must configure the MEP interface in the maintenance association and specify the path as working or protect.

In a sample topology, an MX Series router, MX1, is connected to two other MX Series routers, MX2 and MX3, over an MPLS core. The connectivity fault management (CFM) session between MX1 and MX2 is the working path on the MEP and the CFM session between MX1 and MX3 is the protect path on the MEP. MX2 and MX3 are, in turn, connected on Ethernet interfaces to MX4 in the access network. Downstream MEP is configured between MX1 and MX4 that passes through MX2 (working CFM session) and also between MX1 and MX4 that passes through MX3 (protected CFM session). ETH-SLM is performed between these downstream MEPs. In both the downstream MEPs, the configuration is performed on MX1 and MX4 UNIs, similar to upstream MEP.

### Related Documentation

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Transmission of ETH-SLM Messages on page 639](#)
- [Format of ETH-SLM Messages on page 637](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)



- *Ethernet Interfaces Feature Guide for Routing Devices*

## Format of ETH-SLM Messages

Synthetic loss messages (SLMs) support single-ended Ethernet synthetic loss measurement (ETH-SLM) requests. This topic contains the following sections that describe the formats of the SLM protocol data units (PDUs), SLR PDUs, and the data iterator type length value (TLV).

### SLM PDU Format

The SLM PDU format is used by a MEP to transmit SLM information. The following components are contained in SLM PDUs:

- **Source MEP ID**—Source MEP ID is a 2-octet field where the last 13 least significant bits are used to identify the MEP transmitting the SLM frame. MEP ID is unique within the MEG.
- **Test ID**—Test ID is a 4-octet field set by the transmitting MEP and is used to identify a test when multiple tests run simultaneously between MEPs (including both concurrent on-demand and proactive tests).
- **TxFCf**—TxFCf is a 4-octet field that carries the number of SLM frames transmitted by the MEP toward its peer MEP.

The following are the fields in an SLM PDU:

- **MEG Level**—Configured maintenance domain level in the range 0–7.
- **Version**—0.
- **OpCode**—Identifies an OAM PDU type. For SLM, it is 55.
- **Flags**—Set to all zeros.
- **TLV Offset**—16.
- **Source MEP ID**—A 2-octet field used to identify the MEP transmitting the SLM frame. In this 2-octet field, the last 13 least significant bits are used to identify the MEP transmitting the SLM frame. MEP ID is unique within the MEG.
- **RESV**—Reserved fields are set to all zeros.
- **Test ID**—A 4-octet field set by the transmitting MEP and used to identify a test when multiple tests run simultaneously between MEPs (including both concurrent on-demand and proactive tests).
- **TxFCf**—A 4-octet field that carries the number of SLM frames transmitted by the MEP toward its peer MEP.
- **Optional TLV**—A data TLV may be included in any SLM transmitted. For the purpose of ETH-SLM, the value part of data TLV is unspecified.
- **End TLV**—All zeros octet value.

## SLR PDU Format

The synthetic loss reply (SLR) PDU format is used by a MEP to transmit SLR information. The following are the fields in an SLR PDU:

- MEG Level—A 3-bit field the value of which is copied from the last received SLM PDU.
- Version—A 5-bit field the value of which is copied from the last received SLM PDU.
- OpCode—Identifies an OAM PDU type. For SLR, it is set as 54.
- Flags—A 1-octet field copied from the SLM PDU.
- TLV Offset—A 1-octet field copied from the SLM PDU.
- Source MEP ID—A 2-octet field copied from the SLM PDU.
- Responder MEP ID—A 2-octet field used to identify the MEP transmitting the SLR frame.
- Test ID—A 4-octet field copied from the SLM PDU.
- TxFCf—A 4-octet field copied from the SLM PDU.
- TxFCb—A 4 octet field. This value represents the number of SLR frames transmitted for this test ID.
- Optional TLV—The value is copied from the SLM PDU, if present.
- End TLV—A 1-octet field copied from the SLM PDU.

## Data Iterator TLV Format

The data iterator TLV specifies the data TLV portion of the Y.1731 data frame. The MEP uses a data TLV when the MEP is configured to measure delay and delay variation for different frame sizes. The following are the fields in a data TLV:

- Type—Identifies the TLV type; value for this TLV type is Data (3).
- Length—Identifies the size, in octets, of the Value field containing the data pattern. The maximum value of the Length field is 1440.
- Data pattern—An  $n$ -octet ( $n$  denotes length) arbitrary bit pattern. The receiver ignores it.

### Related Documentation

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Transmission of ETH-SLM Messages on page 639](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)

- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Transmission of ETH-SLM Messages

The ETH-SLM functionality can process multiple synthetic loss message (SLM) requests simultaneously between a pair of MEPs. The session can be a proactive or an on-demand SLM session. Each SLM request is identified uniquely by a test ID.

A MEP can send SLM requests or respond to SLM requests. A response to an SLM request is called a synthetic loss reply (SLR). After a MEP determines an SLM request by using the test ID, the MEP calculates the far-end and near-end frame loss on the basis of the information in the SLM message or the SLM protocol data unit (PDU).

A MEP maintains the following local counters for each test ID and for each peer MEP being monitored in a maintenance entity for which loss measurements are to be performed:

- **TxFCL**—Number of synthetic frames transmitted toward the peer MEP for a test ID. A source MEP increments this number for successive transmission of synthetic frames with ETH-SLM request information while a destination or receiving MEP increments this value for successive transmission of synthetic frames with the SLR information.
- **RxFCL**—Number of synthetic frames received from the peer MEP for a test ID. A source MEP increments this number for successive reception of synthetic frames with SLR information while a destination or receiving MEP increments it for successive reception of synthetic frames with ETH-SLM request information.

The following sections describe the phases of processing of SLM PDUs to determine synthetic frame loss:

### Initiation and Transmission of SLM Requests

A MEP periodically transmits an SLM request with the OpCode field set as 55. The MEP generates a unique Test ID for the session, adds the source MEP ID, and initializes the local counters for the session before SLM initiation. For each SLM PDU transmitted for the session (test ID), the local counter TxFCL is sent in the packet.

No synchronization is required of the test ID value between initiating and responding MEPs because the test ID is configured at the initiating MEP, and the responding MEP uses the test ID it receives from the initiating MEP. Because ETH-SLM is a sampling technique, it is less precise than counting the service frames. Also, the accuracy of measurement depends on the number of SLM frames used or the period for transmitting SLM frames.

### Reception of SLMs and Transmission of SLRs

After the destination MEP receives a valid SLM frame from the source MEP, an SLR frame is generated and transmitted to the requesting or source MEP. The SLR frame is valid if the MEG level and the destination MAC address match the receiving MEP's MAC address.

All the fields in the SLM PDUs are copied from the SLM request except for the following fields:

- The source MAC address is copied to the destination MAC address and the source address contains the MEP's MAC address.
- The value of the OpCode field is changed from SLM to SLR (54).
- The responder MEP ID is populated with the MEP's MEP ID.
- TxFCb is saved with the value of the local counter RxFCI at the time of SLR frame transmission.
- An SLR frame is generated every time an SLM frame is received; therefore, RxFCI in the responder is equal to the number of SLM frames received and also equal to the number of SLR frames sent. At the responder or receiving MEP, RxFCI equals TxFCI.

## Reception of SLRs

After an SLM frame (with a given TxFCf value) is transmitted, a MEP expects to receive a corresponding SLR frame (carrying the same TxTCf value) within the timeout value from its peer MEP. SLR frames that are received after the timeout value (5 seconds) are discarded. With the information contained in SLR frames, a MEP determines the frame loss for the specified measurement period. The measurement period is a time interval during which the number of SLM frames transmitted is statistically adequate to make a measurement at a given accuracy. A MEP uses the following values to determine near-end and far-end frame loss during the measurement period:

- Last received SLR frame's TxFCf and TxFCb values and the local counter RxFCI value at the end of the measurement period. These values are represented as TxFCf[tc], TxFCb[tc], and RxFCI[tc], where tc is the end time of the measurement period.
- SLR frame's TxFCf and TxFCb values of the first received SLR frame after the test starts and local counter RxFCI at the beginning of the measurement period. These values are represented as TxFCf[tp], TxFCb[tp], and RxFCI[tp], where tp is the start time of the measurement period.

For each SLR packet that is received, the local RxFCI counter is incremented at the sending or source MEP.

## Computation of Frame Loss

Synthetic frame loss is calculated at the end of the measurement period on the basis of the value of the local counters and the information from the last frame received. The last received frames contains the TxFCf and TxFCb values. The local counter contains the RxFCI value. Using these values, frame loss is determined using the following formula:

Frame loss (far-end) = TxFCf – TxFCb

Frame loss (near-end) = TxFCb – RxFCI

### Related Documentation

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Format of ETH-SLM Messages on page 637](#)

- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Guidelines for Configuring ETH-SLM

Keep the following points in mind when you configure the ETH-SLM functionality:

- The monitoring application for Ethernet OAM is initiated in the master Routing Engine. When a stateful switchover process occurs, the monitoring application is disabled. For on-demand ETH-SLM, graceful Routing Engine switchover (GRES) support is not applicable. For proactive ETH-SLM, the service-level agreement (SLA) iterators are restored during a stateful switchover process. If the adjacencies do not time out, the ETH-SLM statistics are preserved and proactive ETH-SLM supports GRES.
- ETH-SLM is initiated only when the MEP session is up. Unified in-service software upgrade (ISSU) support for ETH-SLM depends on the unified ISSU support for CFM. For CFM, unified ISSU is supported using the loss threshold TLV to avoid CFM connectivity loss during the upgrade. The receiving or the destination MEP increases the threshold time during the termination of sessions. If you start a unified ISSU operation when on-demand ETH-SLM is in progress, the SLM request and reply messages are lost at the local Packet Forwarding Engine.

When an on-demand ETH-SLM is requested, if the local source MEP undergoes a unified ISSU, a message is displayed stating that the MEP is undergoing a unified ISSU. If the remote MEP is undergoing a unified ISSU (detected through the loss threshold TLV), a message is displayed stating that the remote MEP is undergoing a unified ISSU. Also, if it is not possible to identify whether unified ISSU is in progress on a remote MEP, the SLM packets are lost at the system where unified ISSU is in progress and the loss calculation results do not provide a valid cause for the loss. Unified ISSU is not supported for both on-demand and proactive ETH-SLM.

- The maximum number of SLA iterator profiles that can be configured in the system is 255.
- ETH-SLM is not supported for virtual private LAN service (VPLS) (point-to-multipoint measurements are not supported). The ETH-SLM frames are not generated with multicast class 1 destination address. Similarly, ETH-SLM does not respond to ETH-SLM requests with multicast DA. ETH-SLM for VPLS for point-to-point Ethernet connection is supported using directed unicast destination MAC addresses, although point-to-multipoint topologies are not supported.
- A unicast destination address may be used in provisioned environments for point-to-point connections. However, it requires that the unicast destination address

of the downstream MEP must have been configured on the MEP transmitting an alarm indication signal (AIS).

- ETH-SLM is not supported on aggregated Ethernet (ae) interfaces and on downstream MEPs on label-switched interfaces (LSIs).
- The number of ETH-SLM sessions for proactive ETH-SLM that can be supported is limited to the total number of iterators that can be supported in the system. This limitation includes the iterator support for other measurement types such as loss, statistical frame loss, and two-way delay. A new iterator type, SLM, is added to support ETH-SLM. The total number of SLA iterators that you can configure in the system is equal to the total number of iterations supported in the system.
- For on-demand SLM, the minimum period between two SLM requests is 100 milliseconds.
- For proactive SLM, the minimum period between two SLM requests is 10 milliseconds for distributed mode and 100 milliseconds for non-distributed mode.
- ETH-SLM frames are always marked as drop-ineligible in compliance with the ITU-T Y.1731 standard.

**Related  
Documentation**

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Transmission of ETH-SLM Messages on page 639](#)
- [Format of ETH-SLM Messages on page 637](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Starting a Proactive ETH-SLM Session

To start a proactive Ethernet synthetic loss measurement (ETH-SLM) session, you must configure the Ethernet interfaces on maintenance association end points (MEPs) on which packets transmitted with synthetic frame loss need to be analyzed. You must then create an iterator profile to transmit service-level agreement (SLA) measurement packets for ETH-SLM and associate the local and remote MEPs with the profile.

- [Configuring MEP Interfaces on page 643](#)
- [Configuring an Iterator Profile for ETH-SLM on page 644](#)
- [Associating the Iterator Profile with MEPs for ETH-SLM on page 645](#)

## Configuring MEP Interfaces

Before you can start an Ethernet synthetic frame loss measurement session across an Ethernet service, you must configure two ACX Series routers to support ETH-SLM.

To configure an Ethernet interface on an ACX Series router to support ETH-SLM:

1. On each router, configure two physical or logical Ethernet interfaces connected by a VLAN. The following configuration is typical for single-tagged logical interfaces:

```
[edit interfaces]
interface {
  ethernet-interface-name {
    vlan-tagging;
    unit logical-unit-number {
      vlan-id vlan-id; # Both interfaces on this VLAN
    }
  }
}
```

Both interfaces will use the same VLAN ID.

2. On each router, attach peer MEPs to the two interfaces. The following configuration is typical:

```
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain md-name { # On both routers
        level number;
        maintenance-association ma-name { # On both routers
          continuity-check {
            interval 100ms;
            hold-interval 1;
          }
          mep mep-id { # Attach to VLAN interface
            auto-discovery;
            direction (up | down);
            interface interface-name;
            priority number;
          }
        }
      }
    }
  }
}
```

## Configuring an Iterator Profile for ETH-SLM

You can create an iterator profile with its parameters to periodically transmit SLA measurement packets in the form of ITU-Y.1731-compliant frames for synthetic loss measurement.

To create an iterator profile:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
performance-monitoring
```

2. Configure the SLA measurement monitoring iterator:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# edit sla-iterator-profiles
```

3. Configure an iterator profile—for example, i1:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
user@host# set i1
```

4. (Optional) Configure the cycle time, which is the amount of time (in milliseconds) between back-to-back transmission of SLA frames for one connection, with a value from 10 through 3,600,000. The default value is 1000 ms.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set cycle-time cycle-time-value
```

5. (Optional) Configure the iteration period, which indicates the maximum number of cycles per iteration (the number of connections registered to an iterator cannot exceed this value), with a value from 1 through 2000. The default value is 2000.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set iteration-period iteration-period-value
```

6. Configure the measurement type as synthetic loss measurement.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set measurement-type slm
```

7. Configure the **disable** statement to stop the iterator (that is, disable the iterator profile).

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set disable
```

8. Verify the configuration.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
user@host# show i1
cycle-time cycle-time-value;
iteration-period iteration-period-value;
```



```
measurement-type slm;
```

## Associating the Iterator Profile with MEPs for ETH-SLM

You can associate a remote maintenance association end point (MEP) with more than one iterator profile.

To configure a remote MEP with an iterator profile:

1. In configuration mode, go to the following hierarchy level:

```
user@host# edit protocols oam ethernet connectivity-fault-management
maintenance-domain md-name maintenance-association ma-name mep mep-id
```

2. Configure the remote MEP ID with a value from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id]
user@host# set remote-mep remote-mep-id
```

3. Set the iterator profile.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep
remote-mep-id]
user@host# set sla-iterator-profile profile-name
```

4. (Optional) Set the size of the data TLV portion of the Y.1731 data frame with a value from 1 through 1400 bytes. The default value is 1.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set data-tlv-size size
```

5. (Optional) Set the iteration count, which indicates the number of iterations for which this connection should partake in the iterator for acquiring SLA measurements, with a value from 1 through 65,535. The default value is 0 (that is, infinite iterations).

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set iteration-count count-value
```

6. (Optional) Set the priority, which is the **vlan-pcp** value that is sent in the Y.1731 data frames, with a value from 0 through 7. The default value is 0.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set priority priority-value
```

7. Verify the configuration.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep
remote-mep-id]
user@host# show
sla-iterator-profile profile-name {
  data-tlv-size size;
```

```
        iteration-count count-value;  
        priority priority-value;  
    }
```

**Related  
Documentation**

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Transmission of ETH-SLM Messages on page 639](#)
- [Format of ETH-SLM Messages on page 637](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting an On-Demand ETH-SLM Session on page 646](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Starting an On-Demand ETH-SLM Session

To start an on-demand Ethernet synthetic loss measurement (ETH-SLM) session, type the **monitor ethernet synthetic-loss-measurement one-way** command in operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet synthetic-loss-measurement 00:05:85:73:39:4a  
maintenance-domain md6 maintenance-association ma6 count 10  
ETH-SLM request to 00:05:85:73:39:4a, interface ge-1/0/0.0  
Synthetic Loss measurement statistics:  
  SLM packets sent                      : 100  
  SLR packets received                   : 100  
Accumulated SLM statistics:  
  Local TXFC1 value                     : 100  
  Local RXFC1 value                     : 100  
  Last Received SLR frame TXFCf(tc)     : 100  
  Last Received SLR frame TXFCb(tc)     : 100  
SLM Frame Loss:  
  Frame Loss (far-end)                  : 0 (0.00 %)  
  Frame Loss (near-end)                 : 0 (0.00 %)
```



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must press Ctrl + C to explicitly quit the **monitor ethernet synthetic-loss-measurement** command and return to the CLI command prompt.

---

**Related  
Documentation**

- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
- [Transmission of ETH-SLM Messages on page 639](#)

- [Format of ETH-SLM Messages on page 637](#)
- [Guidelines for Configuring ETH-SLM on page 641](#)
- [Scenarios for Configuration of ETH-SLM on page 635](#)
- [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
- [Starting a Proactive ETH-SLM Session on page 642](#)
- [Troubleshooting Failures with ETH-SLM on page 651](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Managing ETH-SLM Statistics and ETH-SLM Frame Counts

- [Displaying ETH-SLM Statistics Only on page 647](#)
- [Displaying ETH-SLM Statistics and Frame Counts on page 648](#)
- [Displaying ETH-SLM Frame Counts for MEPs by Enclosing CFM Entity on page 648](#)
- [Displaying ETH-SLM Frame Counts for MEPs by Interface or Domain Level on page 649](#)
- [Clearing ETH-SLM Statistics and Frame Counts on page 650](#)
- [Clearing Iterator Statistics on page 650](#)

### Displaying ETH-SLM Statistics Only

**Purpose** Display on-demand ETH-SLM statistics.

By default, the **show oam ethernet connectivity-fault-management synthetic-loss-statistics** command displays on-demand ETH-SLM statistics for MEPs in the specified CFM maintenance association within the specified CFM maintenance domain.

- Action**
- To display the on-demand ETH-SLM statistics collected for MEPs belonging to maintenance association **ma1** within maintenance domain **md1**:  

```
user@host> show oam ethernet connectivity-fault-management synthetic-loss-statistics maintenance-domain md1 maintenance-association ma1
```
  - To display the on-demand ETH-SLM statistics collected for ETH-SLM sessions for the local MEP **201** belonging to maintenance association **ma2** within maintenance domain **md2**:  

```
user@host> show oam ethernet connectivity-fault-management synthetic-loss-statistics maintenance-domain md2 maintenance-association ma2 local-mep 201
```
  - To display the on-demand ETH-SLM statistics collected for ETH-SLM sessions from local MEPs belonging to maintenance association **ma3** within maintenance domain **md3** to the remote MEP **302**:  

```
user@host> show oam ethernet connectivity-fault-management synthetic-loss-statistics maintenance-domain md3 maintenance-association ma3 remote-mep 302
```

**Meaning** The output displays on-demand ETH-SLM statistics for MEPs in the specified maintenance association within the specified maintenance domain. For details about the output of

this command and the descriptions of the output fields, see **show oam ethernet connectivity-fault-management synthetic-loss-statistics**.

## Displaying ETH-SLM Statistics and Frame Counts

**Purpose** Display on-demand ETH-SLM statistics and ETH-SLM frame counts.

By default, the **show oam ethernet connectivity-fault-management mep-statistics** command displays on-demand ETH-SLM statistics and frame counts for MEPs in the specified CFM maintenance association within the specified CFM maintenance domain.

- Action**
- To display the on-demand ETH-SLM statistics and ETH-SLM frame counts for MEPs in maintenance association **ma1** within maintenance domain **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma1
```

- To display the on-demand ETH-SLM statistics and ETH-SLM frame counts for the local MEP **201** in maintenance association **ma2** within maintenance domain **md2**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display the on-demand ETH-SLM statistics and ETH-SLM frame counts for the local MEP in maintenance association **ma3** within maintenance domain **md3** that participates in an ETH-SLM session with the remote MEP **302**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

**Meaning** The output displays on-demand ETH-SLM statistics and ETH-SLM frame counts for MEPs in the specified maintenance association within the specified maintenance domain. For details about the output of this command and the descriptions of the output fields, see **show oam ethernet connectivity-fault-management mep-statistics**.

## Displaying ETH-SLM Frame Counts for MEPs by Enclosing CFM Entity

**Purpose** Display on-demand ETH-SLM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management mep-database** command displays CFM database information for MEPs in the specified CFM maintenance association within the specified CFM maintenance domain.



**NOTE:** At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display the ETH-SLM frame counts and not the MEP database details.

---

- Action**
- To display CFM database information (including ETH-SLM frame counts) for all MEPs in MA **ma1** within maintenance domain **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma1 maintenance-association ma1
```

- To display CFM database information (including ETH-SLM frame counts) only for the local MEP 201 in MA **ma1** within maintenance domain **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display CFM database information (including ETH-SLM frame counts) only for the remote MEP 302 in MA **ma3** within maintenance domain **md3**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

**Meaning** The output displays ETH-SLM frame counts for MEPs within a particular maintenance domain, or for a specific local or remote MEP. For details about the output of this command and the descriptions of the output fields, see **show oam ethernet connectivity-fault-management mep-database**.

## Displaying ETH-SLM Frame Counts for MEPs by Interface or Domain Level

**Purpose** Display on-demand ETH-SLM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management interfaces** command displays CFM database information for MEPs attached to CFM-enabled Ethernet interfaces on the router or at a maintenance domain level. For Ethernet interfaces that support ETH-SLM, any frame counts are also displayed when you specify the **detail** or **extensive** command option.



**NOTE:** At the router attached to the initiator MEP, you can only display the ETH-SLM frame counts and not the MEP database details.

**Action** • To display CFM database information (including ETH-SLM frame counts) for all MEPs attached to CFM-enabled Ethernet interfaces on the router:

```
user@host> show oam ethernet connectivity-fault-management interfaces detail
```

- To display CFM database information (including ETH-SLM frame counts) only for the MEPs attached to CFM-enabled router interface **ge-5/2/9.0**:

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-5/2/9.0 detail
```

- To display CFM database information (including ETH-SLM frame counts) only for MEPs enclosed within CFM maintenance domains at level **6**:

```
user@host> show oam ethernet connectivity-fault-management interfaces level 6 detail
```

**Meaning** The output displays ETH-SLM frame counts for MEPs for the specified interface. For details about the output of this command and the descriptions of the output fields, see **show oam ethernet connectivity-fault-management interfaces**.

## Clearing ETH-SLM Statistics and Frame Counts

**Purpose** Clear the on-demand ETH-SLM statistics and ETH-SLM frame counts.

By default, statistics and frame counts are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

- Action**
- To clear the on-demand ETH-SLM statistics and ETH-SLM frame counts for all MEPs attached to CFM-enabled interfaces on the router:  

```
user@host> clear oam ethernet connectivity-fault-management synthetic-loss-measurement
```
  - To clear the on-demand ETH-SLM statistics and ETH-SLM frame counts only for MEPs attached to the logical interface **ge-0/5.9.0**:  

```
user@host> clear oam ethernet connectivity-fault-management synthetic-loss-measurement ge-0/5/9.0
```

## Clearing Iterator Statistics

**Purpose** Clear the existing iterator statistics and proactive ETH-SLM counters.

Multiple iterators can be associated with remote MEP. However, by default, only one result pertaining to one iterator profile can be cleared.

- Action**
- To clear the iterator statistics for remote MEP 1 and iterator profile i1 with MEPs belonging to the maintenance association **ma1** within the maintenance domain **default-1**:  

```
user@host> clear oam ethernet connectivity-fault-management sla-iterator-statistics sla-iterator i1 maintenance-domain default-1 maintenance-association ma1 local-mep 1 remote-mep 1
```
  - To clear the iterator statistics for remote MEP 1 and iterator profile i2 with MEPs belonging to the maintenance association **ma1** within the maintenance domain **default-1**:  

```
user@host> clear oam ethernet connectivity-fault-management sla-iterator-statistics sla-iterator i2 maintenance-domain default-1 maintenance-association ma1 local-mep 1 remote-mep 1
```

- Related Documentation**
- [clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1276](#)
  - [show oam ethernet connectivity-fault-management synthetic-loss-statistics on page 1774](#)
  - [show oam ethernet connectivity-fault-management interfaces on page 1724 \(detail | extensive\)](#)
  - [show oam ethernet connectivity-fault-management mep-statistics on page 1753](#)
  - [show oam ethernet connectivity-fault-management mep-database on page 1742](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Troubleshooting Failures with ETH-SLM

**Problem**    **Description:** The Ethernet synthetic loss measurement (ETH-SLM) application is not working properly for calculation of frame loss using synthetic frames instead of data traffic

**Solution**    Perform the following steps to analyze and debug any problems with the ETH-SLM functionality.

1. Ensure that ETH-SLM is configured (either proactive or on-demand) to initiate SLM frames. Verify the configuration settings.
2. Examine any failures that might have occurred in the CFM session for which the ETH-SLM feature is enabled. The CFM session must be in the up state for the ETH-SLM functionality to work correctly. Use the **show oam ethernet connectivity-fault-management mep-database maintenance-domain *md-name* maintenance-association *ma-name* local-mep *mep-id* remote-mep *remote-mep-id*** command to verify whether the CFM session is in the up state.
3. If the MEP sessions are active, use the appropriate show command to verify the ETH-SLM statistics and to analyze if ETH-SLM frames are transmitted or received.
4. If the transmission of ETH-SLM frames does not happen correctly after you attempt all of the preceding troubleshooting steps, enable the tracing operations for Ethernet CFM by including the **traceoptions** statement at the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level.

```
[edit protocols oam ethernet connectivity-fault-management]
traceoptions {
  file <filename> <files number> <match regular-expression> microsecond-stamp>>
    <size size> <world-readable | no-world-readable>;
  flag <flag>;
  no-remote-trace;
}
```

- Related Documentation**
- [Ethernet Synthetic Loss Measurement Overview on page 634](#)
  - [Transmission of ETH-SLM Messages on page 639](#)
  - [Format of ETH-SLM Messages on page 637](#)
  - [Guidelines for Configuring ETH-SLM on page 641](#)
  - [Scenarios for Configuration of ETH-SLM on page 635](#)
  - [Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 647](#)
  - [Starting a Proactive ETH-SLM Session on page 642](#)
  - [Starting an On-Demand ETH-SLM Session on page 646](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Configuring an Iterator Profile

---

You can create an iterator profile with its parameters to periodically transmit SLA measurement packets in the form of ITU-Y.1731-compliant frames for delay measurement or loss measurement.

To create an iterator profile:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
performance-monitoring
```

2. Configure the SLA measurement monitoring iterator:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# edit sla-iterator-profiles
```

3. Configure an iterator profile—for example, i1:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
user@host# set i1
```

4. (Optional) Configure the cycle time, which is the amount of time (in milliseconds) between back-to-back transmission of SLA frames for one connection, with values from 10 through 3,600,000. The default value is 1000 ms.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set cycle-time cycle-time-value
```

5. (Optional) Configure the iteration period, which indicates the maximum number of cycles per iteration (the number of connections registered to an iterator cannot exceed this value), with values from 1 through 2000. The default value is 2000.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set iteration-period iteration-period-value
```

6. Configure the measurement type as loss measurement, statistical frame-loss measurement, or two-way delay measurement.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set measurement-type (loss | statistical-frame-loss | two-way-delay)
```

7. (Optional) Configure the calculation weight for delay with values from 1 through 65,535. The default value is 1 (applicable only for two-way delay measurement).

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
user@host# set calculation-weight delay delay-value
```

8. (Optional) Configure the calculation weight for delay variation with values from 1 through 65,535. The default value is 1 (applicable only for two-way delay measurement).



```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set calculation-weight delay-variation delay-variation-value
```

9. (Optional) Configure the threshold value for average frame delay, in microseconds, for two-way Ethernet frame delay measurement (ETH-DM). When the configured threshold for average frame delay is exceeded, an SNMP trap is generated for ETH-DM. The range is from 1 through 4294967295 microseconds.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set avg-fd-twoway-threshold avg-fd-twoway-threshold-value
```

10. (Optional) Configure the threshold value for average frame delay variation, in microseconds, for two-way Ethernet frame delay measurement (ETH-DM). When the configured threshold for average frame delay variation is exceeded, an SNMP trap is generated for ETH-DM. The range is from 1 through 4294967295 microseconds.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set avg-ifdv-twoway-threshold avg-ifdv-twoway-threshold-value
```

11. (Optional) Configure the threshold value for average frame loss ratio, in milli-percent, in the upward or forward direction for Ethernet loss measurement (ETH-LM) and Ethernet synthetic loss measurement (ETH-SLM). When the configured threshold for average forward frame loss ratio is exceeded, an SNMP trap is generated for ETH-LM and ETH-SLM. The range is from 1 through 100000 milli-percent.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set avg-flr-forward-threshold avg-flr-forward-threshold-value
```

12. (Optional) Configure the threshold value for average frame loss ratio, in milli-percent, in the backward or downstream direction for Ethernet loss measurement (ETH-LM) and Ethernet synthetic loss measurement (ETH-SLM). When the configured threshold for average backward frame loss ratio is exceeded, an SNMP trap is generated for ETH-LM and ETH-SLM. The range is from 1 through 100000 milli-percent.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set avg-flr-backward-threshold avg-flr-backward-threshold-value
```

13. Configure the **disable** statement to stop the iterator (that is, disable the iterator profile).

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles i1]
```

```
user@host# set disable
```

14. Verify the configuration.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
```

```
user@host# show i1
```

```
cycle-time cycle-time-value;
```

```
iteration-period iteration-period-value;
```

```
measurement-type (loss | two-way-delay);
```

```
avg-fd-twoway-threshold avg-fd-twoway-threshold-value;
```

```
avg-ifdv-twoway-threshold avg-ifdv-twoway-threshold-value;
```

```
avg-flr-forward-threshold avg-flr-forward-threshold-value;
avg-flr-backward-threshold avg-flr-backward-threshold-value;
calculation-weight {
    delay delay-weight;
    delay-variation delay-variation-weight;
}
calculation-weight {
    delay delay-weight;
    delay-variation delay-variation-weight;
}
```

- Related Documentation**
- [Proactive Mode for SLA Measurement on page 632](#)
  - [Configuring a Remote MEP with an Iterator Profile on page 662](#)
  - [Verifying the Configuration of an Iterator Profile on page 654](#)
  - [Managing Iterator Statistics on page 657](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Verifying the Configuration of an Iterator Profile

The following topics illustrate the configuration of an iterator profile for a two-way delay measurement, for loss measurement, and for a remote maintenance association end point (MEP). The topics also illustrate disabling an iterator profile with the **disable** statement for two-way measurement and deactivating an iterator profile with the **deactivate** command for a remote MEP.

- [Displaying the Configuration of an Iterator Profile for Two-way Delay Measurement on page 654](#)
- [Displaying the Configuration of an Iterator Profile for Loss Measurement on page 655](#)
- [Displaying the Configuration of a Remote MEP with an Iterator Profile on page 656](#)
- [Disabling an Iterator Profile on page 656](#)

### Displaying the Configuration of an Iterator Profile for Two-way Delay Measurement

**Purpose** Display the configuration of an iterator profile for two-way delay measurement as configured in the “[Configuring an Iterator Profile](#)” on [page 652](#) topic with the following values:

- **profile-name**—*il*
- **cycle-time**—**1000** milliseconds
- **iteration-period**—**2000** cycles per second
- **delay**—**1**
- **delay-variation**—**1**:

**Action** To display information about the iterator profile, run the **show** command at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
user@host# show
il {
  cycle-time 1000;
  iteration-period 2000;
  measurement-type two-way-delay;
  calculation-weight {
    delay 1;
    delay-variation 1;
  }
}
```

**Meaning** The configuration for an iterator profile for two-way measurement is displayed as expected with set values.

## Displaying the Configuration of an Iterator Profile for Loss Measurement

**Purpose** Display the configuration of an iterator profile for loss measurement as configured in the [“Configuring an Iterator Profile” on page 652](#) topic with the following values:

- **profile-name—12**
- **cycle-time—1000** milliseconds
- **iteration-period—2000** cycles per second

**Action** To display information about the iterator profile, run the **show** command at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
sla-iterator-profiles]
user@host# show
12 {
  cycle-time 1000;
  iteration-period 2000;
  measurement-type loss;
}
```

**Meaning** The configuration for an iterator profile for loss measurement is displayed as expected with set values.

## Displaying the Configuration of a Remote MEP with an Iterator Profile

**Purpose** Display the configuration of a remoteMEP as configured in the “[Configuring a Remote MEP with an Iterator Profile](#)” on page 662 topic with the following values:

- **profile-name**—i3
- **maintenance-domain**—default-1
- **maintenance-association**—1
- **short-name-format**—2octet
- **mep**—1
- **remote-mep**—1
- **data-tlv-size**—1
- **iteration-count**—1
- **priority**—1

**Action** To display information about the remote MEP, run the **show** command at the **[edit protocols oam ethernet connectivity-fault-management maintenance-domain default-1 maintenance association ma1 mep 1 remote-mep 1]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
 default-1 maintenance association 1 short-name-format 2octet mep 1 remote-mep 1]
user@host# show
sla-iterator-profile i3 {
  data-tlv-size 1;
  iteration-count 1;
  priority 1;
}
```

**Meaning** The configuration for a remote MEP for two-way measurement is displayed as expected with set values.

## Disabling an Iterator Profile

**Purpose** To disable an iterator profile for two-way delay measurement and for a remote MEP.

**Action**

- To disable an iterator profile (for example, i1) with the **disable** configuration command for two-way measurement at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles i1]** hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
 sla-iterator-profiles i1]
user@host# disable
```

- To disable an iterator profile for a remote MEP (for example, i2) with the **deactivate** configuration command at the **[edit protocols oam ethernet**

connectivity-fault-management maintenance-domain default-1 maintenance association  
ma1 mep 1 remote-mep 1] hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
default-1 maintenance association ma1 mep 1 remote-mep 1]
user@host# deactivate sla-iterator-profile i2
```

**Related  
Documentation**

- [Proactive Mode for SLA Measurement on page 632](#)
- [Configuring an Iterator Profile on page 652](#)
- [Configuring a Remote MEP with an Iterator Profile on page 662](#)
- [Managing Iterator Statistics on page 657](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Managing Iterator Statistics

- [Displaying Iterator Statistics on page 657](#)
- [Clearing Iterator Statistics on page 661](#)

### Displaying Iterator Statistics

**Purpose** Retrieve and display iterator statistics.

Multiple iterators can be associated with a remote MEP. However, by default, only one result pertaining to one iterator profile is displayed.

**Action** • To display the iterator statistics for remote MEP 1 and iterator profile i1 with MEPs belonging to the maintenance association **ma1** and within the maintenance domain **default-1** (here, the iterator profile i1 is configured for two-way delay measurement):

```
user@host> show oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator i1 maintenance-domain default-1 maintenance-association ma1 local-mep 1
remote-mep 1
```

Iterator statistics:

```
Maintenance domain: md6, Level: 6
Maintenance association: ma6, Local MEP id: 1000
Remote MEP id: 103, Remote MAC address: 00:90:69:0a:43:92
Iterator name: i1, Iterator Id: 1
Iterator cycle time: 10ms, Iteration period: 1 cycles
Iterator status: running, Infinite iterations: true
Counter reset time: 2010-03-19 20:42:39 PDT (2d 18:24 ago)
Reset reason: Adjacency flap
```

Iterator delay measurement statistics:

```
Delay weight: 1, Delay variation weight: 1
DMM sent : 23898520
DMM skipped for threshold hit : 11000
DMM skipped for threshold hit window : 0
DMR received : 23851165
DMR out of sequence : 1142
DMR received with invalid time stamps : 36540
Average two-way delay : 129 usec
Average two-way delay variation : 15 usec
```

Average one-way forward delay variation : 22 usec  
 Average one-way backward delay variation : 22 usec  
 Weighted average two-way delay : 134 usec  
 Weighted average two-way delay variation : 8 usec  
 Weighted average one-way forward delay variation : 6 usec  
 Weighted average one-way backward delay variation : 2 usec

Output fields are listed in the approximate order in which they appear.

**Table 56: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields**

Output Field Name	Output Field Description
<b>Maintenance domain</b>	Maintenance domain name.
<b>Level</b>	Maintenance domain level configured.
<b>Maintenance association</b>	Maintenance association name.
<b>Local MEP id</b>	Numeric identifier of the local MEP.
<b>Remote MEP id</b>	Numeric identifier of the remote MEP.
<b>Remote MAC address</b>	Unicast MAC address of the remote MEP.
<b>Iterator name</b>	Name of iterator.
<b>Iterator Id</b>	Numeric identifier of the iterator.
<b>Iterator cycle time</b>	Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection
<b>Iteration period</b>	Maximum number of cycles per iteration
<b>Iterator status</b>	Current status of iterator whether running or stopped.
<b>Infinite iterations</b>	Status of iteration as infinite or finite.
<b>Counter reset time</b>	Date and time when the counter was reset.
<b>Reset reason</b>	Reason to reset counter.
<b>Delay weight</b>	Calculation weight of delay.
<b>Delay variation weight</b>	Calculation weight of delay variation.
<b>DMM sent</b>	Delay measurement message (DMM) PDU frames sent to the peer MEP in this session.
<b>DMM skipped for threshold hit</b>	Number of DMM frames sent to the peer MEP in this session skipped during threshold hit.
<b>DMM skipped for threshold hit window</b>	Number of DMM frames sent to the peer MEP in this session skipped during the last threshold hit window.

Table 56: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields (*continued*)

Output Field Name	Output Field Description
DMR received	Number of delay measurement reply (DMR) frames received.
DMR out of sequence	Total number of DMR out of sequence packets received.
DMR received with invalid time stamps	Total number of DMR frames received with invalid timestamps.
Average two-way delay	Average two-way frame delay for the statistics displayed.
Average two-way delay variation	Average two-way "frame jitter" for the statistics displayed.
Average one-way forward delay variation	Average one-way forward delay variation for the statistics displayed in microseconds.
Average one-way backward delay variation	Average one-way backward delay variation for the statistics displayed in microseconds.
Weighted average two-way delay	Weighted average two-way delay for the statistics displayed in microseconds.
Weighted average two-way delay variation	Weighted average two-way delay variation for the statistics displayed in microseconds.
Weighted average one-way forward delay variation	Weighted average one-way forward delay variation for the statistics displayed in microseconds.
Weighted average one-way backward delay variation	Weighted average one-way backward delay variation for the statistics displayed in microseconds.

- To display the iterator statistics for remote MEP 1 and iterator profile i2 with MEPs belonging to the maintenance association **ma1** and within the maintenance domain **default-1** (here, the iterator profile **i1** is configured for loss measurement):

```
user@host> show oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator i2 maintenance-domain default-1 maintenance-association ma1 local-mep 1
remote-mep 1
```

```
Iterator statistics:
```

```
Maintenance domain: md6, Level: 6
Maintenance association: ma6, Local MEP id: 1000
Remote MEP id: 103, Remote MAC address: 00:90:69:0a:43:92
Iterator name: i2, Iterator Id: 2
Iterator cycle time: 1000ms, Iteration period: 2000 cycles
Iterator status: running, Infinite iterations: true
Counter reset time: 2010-03-19 20:42:39 PDT (2d 18:25 ago)
Reset reason: Adjacency flap
```

```
Iterator loss measurement statistics:
```

```
LMM sent : 238970
LMM skipped for threshold hit : 60
LMM skipped for threshold hit window : 0
```

```

LMR received                : 238766
LMR out of sequence         : 43

Accumulated transmit statistics:
Near-end (CIR)              : 0
Far-end (CIR)               : 0
Near-end (EIR)              : 0
Far-end (EIR)               : 0

Accumulated loss statistics:
Near-end (CIR)              : 0 (0.00%)
Far-end (CIR)               : 0 (0.00%)
Near-end (EIR)              : 0 (0.00%)
Far-end (EIR)               : 0 (0.00%)

Last loss measurement statistics:
Near-end (CIR)              : 0
Far-end (CIR)               : 0
Near-end (EIR)              : 0
Far-end (EIR)               : 0

```

Output fields are listed in the approximate order in which they appear.

**Table 57: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields**

Output Field Name	Output Field Description
Maintenance domain	Maintenance domain name.
Level	Maintenance domain level configured.
Maintenance association	Maintenance association name.
Local MEP id	Numeric identifier of the local MEP.
RemoteMEP identifier	Numeric identifier of the remote MEP.
Remote MAC address	Unicast MAC address of the remote MEP.
Iterator name	Name of iterator.
Iterator Id	Numeric identifier of the iterator.
Iterator cycle time	Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection
Iteration period	Maximum number of cycles per iteration
Iterator status	Current status of iterator whether running or stopped.
Infinite iterations	Status of iteration as infinite or finite.
Counter reset time	Date and time when the counter was reset.
Reset reason	Reason to reset counter.



Table 57: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields (*continued*)

Output Field Name	Output Field Description
LMM sent	Number of loss measurement message (LMM) PDU frames sent to the peer MEP in this session.
LMM skipped for threshold hit	Number of LMM frames sent to the peer MEP in this session skipped during threshold hit.
LMM skipped for threshold hit window	Number of LMM frames sent to the peer MEP in this session skipped during the last threshold hit window.
LMR received	Number of LMRs frames received.
LMR out of sequence	Total number of LMR out of sequence packets received.
Near-end (CIR)	Frame loss associated with ingress data frames for the statistics displayed.
Far-end (CIR)	Frame loss associated with egress data frames for the statistics displayed.
Near-end (EIR)	Frame loss associated with ingress data frames for the statistics displayed.
Far-end (EIR)	Frame loss associated with egress data frames for the statistics displayed.

## Clearing Iterator Statistics

**Purpose** Clear iterator statistics.

Multiple iterators can be associated with remote MEP. However, by default, only one result pertaining to one iterator profile can be cleared.

- Action**
- To clear the iterator statistics for remote MEP 1 and iterator profile i1 with MEPs belonging to the maintenance association **ma1** and within the maintenance domain **default-1**:

```
user@host> clear oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator i1 maintenance-domain default-1 maintenance-association ma1 local-mep 1
remote-mep 1
```

- To clear the iterator statistics for remote MEP 1 and iterator profile i2 with MEPs belonging to the maintenance association **ma1** and within the maintenance domain **default-1**:

```
user@host> clear oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator i2 maintenance-domain default-1 maintenance-association ma1 local-mep 1
remote-mep 1
```

- Related Documentation**
- [Configuring an Iterator Profile on page 652](#)
  - [Configuring a Remote MEP with an Iterator Profile on page 662](#)
  - [Verifying the Configuration of an Iterator Profile on page 654](#)

- [Proactive Mode for SLA Measurement on page 632](#)

## Configuring a Remote MEP with an Iterator Profile

You can associate a remote maintenance association end point (MEP) with more than one iterator profile.

To configure a remote MEP with an iterator profile:

1. In configuration mode, go to the following hierarchy level:

```
user@host# edit protocols oam ethernet connectivity-fault-management
maintenance-domain md-name maintenance-association ma-name mep mep-id
```

2. Configure the remote MEP with values from 1 through 8191.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id]
user@host# set remote-mep remote-mep-id
```

3. Set the iterator profile.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep
remote-mep-id]
user@host# set sla-iterator-profile profile-name
```

4. (Optional) Set the size of the data TLV portion of the Y.1731 data frame with values from 1 through 1400 bytes. The default value is 1.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set data-tlv-size size
```

5. (Optional) Set the iteration count, which indicates the number of iterations for which this connection should partake in the iterator for acquiring SLA measurements, with values from 1 through 65,535. The default value is 0 (that is, infinite iterations).

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set iteration-count count-value
```

6. (Optional) Set the priority, which is the **vlan-pcp** value that is sent in the Y.1731 data frames, with values from 0 through 7. The default value is 0.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id
sla-iterator-profile profile-name]
user@host# set priority priority-value
```

7. Verify the configuration.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
md-name maintenance-association ma-name mep mep-id remote-mep
remote-mep-id]
user@host# show
```

```
sla-iterator-profile profile-name {
  data-tlv-size size;
  iteration-count count-value;
  priority priority-value;
}
```

**Related  
Documentation**

- [Proactive Mode for SLA Measurement on page 632](#)
- [Configuring an Iterator Profile on page 652](#)
- [Verifying the Configuration of an Iterator Profile on page 654](#)
- [Managing Iterator Statistics on page 657](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Statistical Frame Loss Measurement for VPLS Connections

Using proactive statistical frame loss measurement, you can monitor VPLS connections on MX Series routers. Statistical frame loss measurement allows you to monitor the quality of Ethernet connections for service level agreements (SLAs). Point-to-point and multipoint-to-multipoint connections configured on MX Series routers can be monitored by registering the connection on an iterator and initiating periodic SLA measurement of frame transmissions on the connections.

Iterators periodically transmit SLA measurement packets using ITU-Y.1731 compliant frames. The iterator sends periodic measurement packets for each of the connections registered to it. These measurement cycles are transmitted in such a way as to not overlap, reducing the processing demands placed on the CPU. The measurement packets are exchanged between the source user network interface (UNI) port and the destination UNI port, providing a sequence of timed performance measurements for each UNI pair. The Frame Loss Ratio (FLR) and connection availability can be computed from these measurements using statistics.

The following steps outline how to configure statistical frame loss measurement for VPLS connections:

1. To configure proactive ETH-DM measurement for a VPLS connection, see [“Guidelines for Configuring Routers to Support an ETH-DM Session” on page 664](#).
2. To enable statistical loss measurement for a VPLS connection, configure an iterator for the VPLS connection using the `sla-iterator-profiles` statement at the `[edit protocols oam ethernet connectivity-fault-management performance-monitoring]` hierarchy level. For detailed instructions, see [“Configuring an Iterator Profile” on page 652](#).
3. As part of the iterator configuration, include the `statistical-frame-loss` option for the `measurement-type` statement at the `[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]` hierarchy level.
4. Once you have enabled the iterator, you can display the statistical frame loss for a VPLS connection by issuing the `show oam ethernet connectivity-fault-management`

**sla-iterator-statistics sla-iterator *identifier* maintenance-domain *name***  
**maintenance-association *name* local-mep *identifier* remote-mep *identifier*** command.

- Related Documentation**
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
  - [Configuring an Iterator Profile on page 652](#)
  - [Verifying the Configuration of an Iterator Profile on page 654](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Guidelines for Configuring Routers to Support an ETH-DM Session

Keep the following guidelines in mind when configuring routers to support an Ethernet frame delay measurement (ETH-DM) session:

- [Configuration Requirements for ETH-DM on page 664](#)
- [Configuration Options for ETH-DM on page 665](#)

### Configuration Requirements for ETH-DM

You can obtain ETH-DM information for a link that meets the following requirements:

- The measurements can be performed between peer maintenance association endpoints (MEPs) on two routers.
- The two MEPs must be configured on two Ethernet physical interfaces or on two Ethernet logical interfaces. For more information, see [“Configuring a MEP to Generate and Respond to CFM Protocol Messages” on page 530](#).
- The two MEPs must be configured—on their respective routers—under the same maintenance association (MA) identifier. For more information, see [“Creating a Maintenance Association” on page 528](#).
- On both routers, the MA must be associated with the same maintenance domain (MD) name. For more information, see [“Creating a Maintenance Domain” on page 525](#).
- On both routers, periodic packet management (PPM) must be running on the Routing Engine and Packet Forwarding Engine, which is the default configuration. You can disable PPM on the Packet Forwarding Engine only. However, the Ethernet frame delay measurement feature requires that distributed PPM remain enabled on the Packet Forwarding Engine of both routers. For more information about **ppm**, see the *Junos OS Routing Protocols Library for Routing Devices*.
- If the PPM process (**ppm**) is disabled on the Packet Forwarding Engine, you must re-enable it. Re-enabling distributed **ppm** entails restarting the **ethernet-connectivity-fault-management** process, which causes all connectivity fault management (CFM) sessions to re-establish. For more information about CFM sessions, see [“Configuring Ethernet Local Management Interface” on page 540](#).



**NOTE:** The Ethernet frame delay measurement feature is supported only for MEPs configured on Ethernet physical or logical interfaces on DPCs in MX Series routers. The ETH-DM feature is not supported on aggregated Ethernet interfaces or LSI pseudowires.

## Configuration Options for ETH-DM

By default, the ETH-DM feature calculates frame delays using software-based timestamping of the ETH-DM PDU frames sent and received by the MEPs in the session. As an option that can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction, you can enable hardware-assisted timestamping of session frames in the receive direction.

### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Configuring Routers to Support an ETH-DM Session on page 671](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Guidelines for Starting an ETH-DM Session

Keep the following guidelines in mind when preparing to start an Ethernet frame delay measurement (ETH-DM) session:

- [ETH-DM Session Prerequisites on page 665](#)
- [ETH-DM Session Parameters on page 666](#)
- [Restrictions for an ETH-DM Session on page 666](#)

### ETH-DM Session Prerequisites

Before you can start an ETH-DM session, you must configure two MX Series routers to support ETH-DM by defining the two CFM-enabled physical or logical Ethernet interfaces on each router. This entails creating and configuring CFM maintenance domains, maintenance associations, and maintenance association end points on each router. For more information about enabling CFM on an Ethernet interface, see [“Creating a Maintenance Domain” on page 525](#).



**NOTE:** The Ethernet frame delay measurement feature is supported only for maintenance association end points configured on Ethernet physical or logical interfaces on DPCs in MX Series routers. The ETH-DM feature is not supported on aggregated Ethernet interfaces or LSI pseudowires.

For specific information about configuring routers to support ETH-DM, see [“Guidelines for Configuring Routers to Support an ETH-DM Session” on page 664](#) and [“Configuring Routers to Support an ETH-DM Session” on page 671](#).

## ETH-DM Session Parameters

You can initiate a one-way or two-way ETH-DM session by entering the **monitor ethernet delay-measurement** operational command at a router that contains one end of the service for which you want to measure frame delay. The command options specify the ETH-DM session in terms of the CFM elements:

- The type of ETH-DM measurement (one-way or two-way) to be performed.
- The Ethernet service for which the ETH-DM measurement is to be performed:
  - CFM maintenance domain—Name of the existing maintenance domain (MD) for which you want to measure Ethernet frame delays. For more information, see [“Creating a Maintenance Domain” on page 525](#).
  - CFM maintenance association—Name of an existing maintenance association (MA) within the maintenance domain. For more information, see [“Creating a Maintenance Association” on page 528](#).
  - Remote CFM maintenance association end point—The unicast MAC address or the numeric identifier of the remote maintenance association end point (MEP)—the physical or logical interface on the remote router that resides in the specified MD and is named in the specified MA—with which to perform the ETH-DM session. For more information, see [“Configuring a MEP to Generate and Respond to CFM Protocol Messages” on page 530](#).
- Optional specifications:
  - Count—You can specify the number of ETH-DM requests to send for this frame delay measurement session. The range is from 1 through 65,535 frames. The default value is 10 frames.

**NOTE:** Although you can trigger frame delay collection for up to 65,535 ETH-DM requests at a time, a router stores only the last 100 frame delay statistics per CFM session (pair of peer MEPs).
  - Frame interval—You can specify the number of seconds to elapse between ETH-DM frame transmittals. The default value is 1 second.

For more detailed information about the parameters you can specify to start an ETH-DM session, see the **monitor ethernet delay-measurement** operational command description in the [CLI Explorer](#).

## Restrictions for an ETH-DM Session

The following restrictions apply to an ETH-DM session:

- You cannot run multiple simultaneous ETH-DM sessions with the same remote MEP or MAC address.
- For a given ETH-DM session, you can collect frame delay information for a maximum of 65,535 frames.

- For a given CFM session (pair of peer MEPs), the ETH-DM database stores a maximum of 100 statistics, with the older statistics being “aged out” as newer statistics are collected for that pair of MEPs.
- For one-way delay measurements collected within the same CFM session, the 100 most recent ETH-DM statistics can be retrieved at any point of time at the router on which the receiver MEP is defined.
- For two-way delay measurements collected within the same CFM session, the 100 most recent ETH-DM statistics can be retrieved at any point of time at the router on which the initiator MEP is defined.

Depending on the number of frames exchanged in the individual ETH-DM sessions, the ETH-DM database can contain statistics collected through multiple ETH-DM sessions.

- If graceful Routing Engine switchover (GRES) occurs, any collected ETH-DM statistics are lost, and ETH-DM frame counts are reset to zeroes. GRES enables a router with dual Routing Engines to switch from a master Routing Engine to a backup Routing Engine without interruption to packet forwarding. For more information, see the *Junos OS High Availability Library for Routing Devices*.
- Accuracy of frame delay data is compromised when the system is changing (such as from reconfiguration). We recommend performing Ethernet frame delay measurements on a stable system.

#### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Starting an ETH-DM Session on page 675](#)
- [Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 667](#)
- **monitor ethernet delay-measurement** operational command
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts

- [ETH-DM Statistics on page 667](#)
- [ETH-DM Statistics Retrieval on page 669](#)
- [ETH-DM Frame Counts on page 669](#)
- [ETH-DM Frame Count Retrieval on page 670](#)

### ETH-DM Statistics

Ethernet frame delay statistics are the frame delay and frame delay variation values determined by the exchange of frames containing ETH-DM protocol data units (PDUs).

- For a one-way ETH-DM session, statistics are collected in an ETH-DM database at the router that contains the receiver MEP. For a detailed description of one-way Ethernet frame delay measurement, including the exchange of one-way delay PDU frames, see [“Ethernet Frame Delay Measurements Overview” on page 622](#).

- For a two-way ETH-DM session, statistics are collected in an ETH-DM database at the router that contains the initiator MEP. For a detailed description of two-way Ethernet frame delay measurement, including the exchange of two-way delay PDU frames, see [“Ethernet Frame Delay Measurements Overview” on page 622](#).

A CFM database stores CFM-related statistics and—for Ethernet interfaces that support ETH-DM—the 100 most recently collected ETH-DM statistics for that pair of MEPs. You can view ETH-DM statistics by using the **delay-statistics** or **mep-statistics** form of the **show oam ethernet connectivity-fault-management** command to display the CFM statistics for the MEP that collects the ETH-DM statistics you want to view.

[Table 58 on page 668](#) describes the ETH-DM statistics calculated in an ETH-DM session.

**Table 58: ETH-DM Statistics**

Field Name	Field Description
<b>One-way delay (µsec)<sup>†</sup></b>	<p>For a one-way ETH-DM session, the frame delay, in microseconds, collected at the receiver MEP.</p> <p>To display frame delay statistics for a given one-way ETH-DM session, use the <b>delay-statistics</b> or <b>mep-statistics</b> form of the <b>show oam ethernet connectivity-fault-management</b> command at the receiver MEP for that session.</p>
<b>Two-way delay (µsec)</b>	<p>For a two-way ETH-DM session, the frame delay, in microseconds, collected at the initiator MEP.</p> <p>When you start a two-way frame delay measurement, the CLI output displays each DMR frame receipt timestamp and corresponding DMM frame delay and delay variation collected as the session progresses.</p> <p>To display frame delay statistics for a given two-way ETH-DM session, use the <b>delay-statistics</b> or <b>mep-statistics</b> form of the <b>show oam ethernet connectivity-fault-management</b> command at the initiator MEP for that session.</p>
<b>Average delay<sup>†</sup></b>	<p>When you start a two-way frame delay measurement, the CLI output includes a runtime display of the average two-way frame delay among the statistics collected for the ETH-DM session only.</p> <p>When you display ETH-DM statistics using a <b>show</b> command, the <b>Average delay</b> field displays the average one-way and two- frame delays among all ETH-DM statistics collected at the CFM session level.</p> <p>For example, suppose you start two one-way ETH-DM sessions for 50 counts each, one after the other. If, after both measurement sessions complete, you use a <b>show</b> command to display 100 ETH-DM statistics for that CFM session, the <b>Average delay</b> field displays the average frame delay among all 100 statistics.</p>
<b>Average delay variation<sup>†</sup></b>	<p>When you start a two-way frame delay measurement, the CLI output includes a runtime display of the average two-way frame delay variation among the statistics collected for the ETH-DM session only.</p> <p>When you display ETH-DM statistics using a <b>show</b> command, the <b>Average delay variation</b> field displays the average one-way and two- frame delay variations among all ETH-DM statistics collected at the CFM session level.</p>



Table 58: ETH-DM Statistics (*continued*)

Field Name	Field Description
<b>Best-case delay</b> <sup>†</sup>	<p>When you start a two-way frame delay measurement, the CLI output includes a runtime display of the lowest two-way frame delay value among the statistics collected for the ETH-DM session only.</p> <p>When you display ETH-DM statistics using a <b>show</b> command, the <b>Best case delay</b> field displays the lowest one-way and two-way frame delays among all ETH-DM statistics collected at the CFM session level.</p>
<b>Worst-case delay</b> <sup>†</sup>	<p>When you start a two-way frame delay measurement, the CLI output includes a runtime display of the highest two-way frame delay value among the statistics collected for the ETH-DM session only.</p> <p>When you display ETH-DM statistics using a <b>show</b> command, the <b>Worst case delay</b> field displays the highest one-way and two-way frame delays among all statistics collected at the CFM session level.</p>
<p><sup>†</sup>When you start a one-way frame delay measurement, the CLI output displays <b>NA</b> ("not available") for this field. One-way ETH-DM statistics are collected at the remote (receiver) MEP. Statistics for a given one-way ETH-DM session are available only by displaying CFM statistics for the receiver MEP.</p>	

## ETH-DM Statistics Retrieval

At the receiver MEP for a one-way session, or at the initiator MEP for a two-way session, you can display all ETH-DM statistics collected at a CFM session level by using the following operational commands:

- **show oam ethernet connectivity-fault-management delay-statistics**  
**maintenance-domain** *md-name* **maintenance-association** *ma-name* **<local-mep mep-id>**  
**<remote-mep mep-id>** **<count count>**
- **show oam ethernet connectivity-fault-management mep-statistics**  
**maintenance-domain** *md-name* **maintenance-association** *ma-name* **<local-mep mep-id>**  
**<remote-mep mep-id>** **<count count>**

## ETH-DM Frame Counts

The number of ETH-DM PDU frames exchanged in a ETH-DM session are stored in the CFM database on each router.

[Table 59 on page 669](#) describes the ETH-DM frame counts collected in an ETH-DM session.

Table 59: ETH-DM Frame Counts

Field Name	Field Description
<b>IDMs sent</b>	<p>Number of one-way delay measurement (IDM) PDU frames sent to the peer MEP in this session.</p> <p>Stored in the CFM database of the MEP initiating a one-way frame delay measurement.</p>

Table 59: ETH-DM Frame Counts (*continued*)

Field Name	Field Description
<b>Valid 1DMs received</b>	Number of valid 1DM frames received.  Stored in the CFM database of the MEP receiving a one-way frame delay measurement.
<b>Invalid 1DMs received</b>	Number of invalid 1DM frames received.  Stored in the CFM database of the MEP receiving a one-way frame delay measurement.
<b>DMMs sent</b>	Number of delay measurement message (DMM) PDU frames sent to the peer MEP in this session.  Stored in the CFM database of the MEP initiating a two-way frame delay measurement.
<b>DMRs sent</b>	Number of delay measurement reply (DMR) frames sent (in response to a received DMM).  Stored in the CFM database of the MEP responding to a two-way frame delay measurement.
<b>Valid DMRs received</b>	Number of valid DMR frames received.  Stored in the CFM database of the MEP initiating a two-way frame delay measurement.
<b>Invalid DMRs received</b>	Number of invalid DMR frames received.  Stored in the CFM database of the MEP initiating a two-way frame delay measurement.

## ETH-DM Frame Count Retrieval

Each router counts the number of ETH-DM frames sent or received and stores the counts in a CFM database.

### Frame Counts Stored in CFM Databases

You can display ETH-DM frame counts for MEPs assigned to specified Ethernet interfaces or for specified MEPs in CFM sessions by using the following operational commands:

- `show oam ethernet connectivity-fault-management interfaces (detail | extensive)`
- `show oam ethernet connectivity-fault-management mep-database maintenance-domain md-name maintenance-association ma-name <local-mep mep-id> <remote-mep mep-id>`

### One-Way ETH-DM Frame Counts

For a one-way ETH-DM session, delay statistics are collected at the receiver MEP only, but frame counts are collected at both MEPs. As indicated in [Table 59 on page 669](#), one-way ETH-DM frame counts are tallied from the perspective of each router in the session:

- At the initiator MEP, the router counts the number of 1DM frames sent.
- At the receiver MEP, the router counts the number of valid 1DM frames received and the number of invalid 1DM frames received.

You can also view one-way ETH-DM frame counts—for a receiver MEP—by using the **show oam ethernet connectivity-fault-management mep-statistics** command to display one-way statistics and frame counts together.

### Two-Way ETH-DM Frame Counts

For a two-way ETH-DM session, delay statistics are collected at the initiator MEP only, but frame counts are collected at both MEPs. As indicated in [Table 59 on page 669](#), two-way ETH-DM frame counts are tallied from the perspective of each router in the session:

- At the initiator MEP, the router counts the number of DMM frames sent, valid DMR frames received, and invalid DMR frames received.
- At the responder MEP, the router counts the number of DMR frames sent.

You can also view two-way ETH-DM frame counts—for an initiator MEP—by using the **show oam ethernet connectivity-fault-management mep-statistics** command to display two-way statistics and frame counts together.

#### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Managing ETH-DM Statistics and ETH-DM Frame Counts on page 679](#)
- *Example: One-Way Ethernet Frame Delay Measurement*
- [clear oam ethernet connectivity-fault-management statistics on page 1275](#) command
- [show oam ethernet connectivity-fault-management mep-statistics on page 1753](#) command
- [show oam ethernet connectivity-fault-management delay-statistics on page 1716](#) command
- [show oam ethernet connectivity-fault-management interfaces on page 1724 \(detail | extensive\)](#) command
- [show oam ethernet connectivity-fault-management mep-database on page 1742](#) command
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Configuring Routers to Support an ETH-DM Session

- [Configuring MEP Interfaces on page 671](#)
- [Ensuring That Distributed ppm Is Not Disabled on page 673](#)
- [Enabling the Hardware-Assisted Timestamping Option on page 674](#)
- [Configuring the Server-Side Processing Option on page 675](#)

### Configuring MEP Interfaces

Before you can start an Ethernet frame delay measurement session across an Ethernet service, you must configure two MX Series routers to support ETH-DM.

To configure an Ethernet interface on a MX Series router to support ETH-DM:

1. On each router, configure two physical or logical Ethernet interfaces connected by a VLAN. The following configuration is typical for single-tagged logical interfaces:

```
[edit interfaces]
interface {
  ethernet-interface-name {
    vlan-tagging;
    unit logical-unit-number {
      vlan-id vlan-id; # Both interfaces on this VLAN
    }
  }
}
```

Both interfaces will use the same VLAN ID.

2. On each router, attach peer MEPS to the two interfaces. The following configuration is typical:

```
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain md-name { # On both routers
        level number;
        maintenance-association ma-name { # On both routers
          continuity-check {
            interval 100ms;
            hold-interval 1;
          }
          mep mep-id { # Attach to VLAN interface
            auto-discovery;
            direction (up | down);
            interface interface-name;
            priority number;
          }
        }
      }
    }
  }
}
```

## Ensuring That Distributed ppm Is Not Disabled

By default, the router's period packet management process (**ppm**) runs sessions distributed to the Packet Forwarding Engine in addition to the Routing Engine. This process is responsible for periodic transmission of packets on behalf of its various client processes, such as Bidirectional Forwarding Detection (BFD), and it also receives packets on behalf of client processes.

In addition, **ppm** handles time-sensitive periodic processing and performs such processes as sending process-specific packets and gathering statistics. With **ppm** processes running distributed on both the Routing Engine and the Packet Forwarding Engine, you can run such processes as BFD on the Packet Forwarding Engine.

### Distributed ppm Required for ETH-DM

Ethernet frame delay measurement requires that **ppm** remains distributed to the Packet Forwarding Engine. If **ppm** is not distributed to the Packet Forwarding Engines of both routers, ETH-DM PDU frame timestamps and ETH-DM statistics are not valid.

Before you start ETH-DM, you must verify that the following configuration statement is *NOT* present:

```
[edit]
routing-options {
  ppm {
    no-delegate-processing;
  }
}
```

If distributed **ppm** processing is disabled (as shown in the stanza above) on either router, you must re-enable it in order to use the ETH-DM feature.

### Procedure to Ensure that Distributed ppm is Not Disabled

To ensure that distributed **ppm** is not disabled on a router:

1. Display the packet processing management (PPM) configuration to determine whether distributed **ppm** is disabled.

- In the following example, distributed **ppm** is enabled on the router. In this case, you do not need to modify the router configuration:

```
[edit]
user@host# show routing-options
ppm;
```

- In the following example, distributed **ppm** is disabled on the router. In this case, you must proceed to Step 2 to modify the router configuration:

```
[edit]
user@host# show routing-options
ppm {
  no-delegate-processing;
}
```

2. Modify the router configuration to re-enable distributed **ppm** and restart the Ethernet OAM Connectivity Fault Management process *ONLY IF* distributed **ppm** is disabled (as determined in the previous step).

- a. Before continuing, make any necessary preparations for the possible loss of connectivity on the router.

Restarting the **ethernet-connectivity-fault-management** process has the following effect on your network:

- All connectivity fault management (CFM) sessions re-establish.
- All ETH-DM requests on the router terminate.
- All ETH-DM statistics and frame counts reset to 0.

- b. Modify the router configuration to re-enable distributed **ppm**. For example:

```
[edit]
user@host# delete routing-options ppm no-delegate-processing
```

- c. Commit the updated router configuration. For example:

```
[edit]
user@host# commit and-quit
commit complete
exiting configuration mode
```

- d. To restart the Ethernet OAM Connectivity-Fault-Management process, enter the **restart ethernet-connectivity-fault-management <gracefully | immediately | soft>** operational mode command. For example:

```
user@host> restart ethernet-connectivity-fault-management
Connectivity fault management process started, pid 9893
```

## Enabling the Hardware-Assisted Timestamping Option

By default, Ethernet frame delay measurement uses software for timestamping transmitted and received ETH-DM frames. For Ethernet interfaces, you can optionally use hardware timing to assist in the timestamping of received ETH-DM frames to increase the accuracy of delay measurements.

Enabling hardware-assisted timestamping of received frames can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction.

To enable Ethernet frame delay measurement hardware assistance on the reception path, include the **hardware-assisted-timestamping** statement at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring]** hierarchy level:

```
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      performance-monitoring {
        hardware-assisted-timestamping;
      }
    }
  }
}
```

```

    }
  }
}

```

## Configuring the Server-Side Processing Option

You can delegate the server-side processing (for both two-way delay measurement and loss measurement) to the Packet Forwarding Engine to prevent overloading on the Routing Engine. By default, the server-side processing is done by the Routing Engine.

To configure the server-side processing option:

1. In configuration mode, go to the following hierarchy level:

```

user@host# edit protocols oam ethernet connectivity-fault-management
performance-monitoring

```

2. Configure the server-side processing option.

```

[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# set delegate-server-processing

```

3. Verify the configuration.

```

[edit protocols oam ethernet connectivity-fault-management]
user@host# show
performance-monitoring {
  delegate-server-processing;
}

```

### Related Documentation

- [On-Demand Mode for SLA Measurement on page 631](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)

## Starting an ETH-DM Session

- [Using the monitor ethernet delay-measurement Command on page 675](#)
- [Starting a One-Way ETH-DM Session on page 676](#)
- [Starting a Two-Way ETH-DM Session on page 677](#)

## Using the monitor ethernet delay-measurement Command

After you have configured two MX Series routers to support ITU-T Y.1731 Ethernet frame delay measurement (ETH-DM), you can initiate a one-way or two-way Ethernet frame

delay measurement session from the CFM maintenance association end point (MEP) on one of the routers to the peer MEP on the other router.

To start an ETH-DM session between the specified local MEP and the specified remote MEP, enter the **monitor ethernet delay-measurement** command at operational mode. The syntax of the command is as follows:

```
monitor ethernet delay-measurement
(one-way | two-way)
maintenance-domain md-name
maintenance-association ma-name
(remote-mac-address | mep remote-mep-id)
<count frame-count>
<wait interval-seconds>
<priority 802.1p value>
<size>
<no-session-id-tlv>
<xml>
```

For a one-way frame delay measurement, the command displays a runtime display of the number of 1DM frames sent from the initiator MEP during that ETH-DM session. One-way frame delay and frame delay variation measurements from an ETH-DM session are collected in a CFM database at the router that contains the receiver MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.

For a two-way frame delay measurement, the command displays two-way frame delay and frame delay variation values for each round-trip frame exchange during that ETH-DM session, as well as a runtime display of useful summary information about the session: average delay, average delay variation, best-case delay, and worst-case delay. Two-way frame delay and frame delay variation values measurements from an ETH-DM session are collected in a CFM database at the router that contains the initiator MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.



**NOTE:** Although you can trigger frame delay collection for up to 65,535 ETH-DM requests at a time, a router stores only the last 100 frame delay statistics per CFM session (pair of peer MEPs).

For a complete description of the **monitor ethernet delay-measurement** operational command, see the [CLI Explorer](#).

## Starting a One-Way ETH-DM Session

To start a one-way Ethernet frame delay measurement session, enter the **monitor ethernet delay-measurement one-way** command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement one-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
One-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
1DM Frames sent : 10
--- Delay measurement statistics ---
```



Packets transmitted: 10  
 Average delay: NA, Average delay variation: NA  
 Best case delay: NA, Worst case delay: NA



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must type Ctrl + C to explicitly quit the **monitor ethernet delay-measurement** command and return to the CLI command prompt.

## Starting a Two-Way ETH-DM Session

To start a two-way Ethernet frame delay measurement session, enter the **monitor ethernet delay-measurement two-way** command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement two-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
Two-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
DMR received from 00:05:85:73:39:4a Delay: 100 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 8 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 111 usec Delay variation: 19 usec
DMR received from 00:05:85:73:39:4a Delay: 110 usec Delay variation: 1 usec
DMR received from 00:05:85:73:39:4a Delay: 119 usec Delay variation: 9 usec
DMR received from 00:05:85:73:39:4a Delay: 122 usec Delay variation: 3 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 30 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 108 usec Delay variation: 16 usec

--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 10
Average delay: 103 usec, Average delay variation: 8 usec
Best case delay: 92 usec, Worst case delay: 122 usec
```



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must type Ctrl + C to explicitly quit the **monitor ethernet delay-measurement** command and return to the CLI command prompt.

### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Starting an ETH-DM Session on page 665](#)
- **monitor ethernet delay-measurement** command
- [Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 667](#)
- [Managing ETH-DM Statistics and ETH-DM Frame Counts on page 679](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Starting a One-Way ETH-DM Session

To start a one-way Ethernet frame delay measurement session, enter the **monitor ethernet delay-measurement one-way** command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement one-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
One-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
1DM Frames sent : 10
--- Delay measurement statistics ---
Packets transmitted: 10
Average delay: NA, Average delay variation: NA
Best case delay: NA, Worst case delay: NA
```



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must type Ctrl + C to explicitly quit the **monitor ethernet delay-measurement** command and return to the CLI command prompt.

Related Documentation • [monitor ethernet delay-measurement on page 1282](#)

## Starting a Two-Way ETH-DM Session

To start a two-way Ethernet frame delay measurement session, enter the **monitor ethernet delay-measurement two-way** command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement two-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
Two-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
DMR received from 00:05:85:73:39:4a Delay: 100 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 8 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 111 usec Delay variation: 19 usec
DMR received from 00:05:85:73:39:4a Delay: 110 usec Delay variation: 1 usec
DMR received from 00:05:85:73:39:4a Delay: 119 usec Delay variation: 9 usec
DMR received from 00:05:85:73:39:4a Delay: 122 usec Delay variation: 3 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 30 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 108 usec Delay variation: 16 usec

--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 10
Average delay: 103 usec, Average delay variation: 8 usec
Best case delay: 92 usec, Worst case delay: 122 usec
```



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must type **Ctrl + C** to explicitly quit the **monitor ethernet delay-measurement** command and return to the CLI command prompt.

**Related Documentation**

- [monitor ethernet delay-measurement on page 1282](#)

## Managing ETH-DM Statistics and ETH-DM Frame Counts

- [Displaying ETH-DM Statistics Only on page 679](#)
- [Displaying ETH-DM Statistics and Frame Counts on page 679](#)
- [Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity on page 680](#)
- [Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level on page 680](#)
- [Clearing ETH-DM Statistics and Frame Counts on page 681](#)

### Displaying ETH-DM Statistics Only

**Purpose** Display ETH-DM statistics.

By default, the **show oam ethernet connectivity-fault-management delay-statistics** command displays ETH-DM statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

- Action**
- To display the ETH-DM statistics collected for MEPs belonging to MA **ma1** and within MD **md1**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain ma1 maintenance-association ma1
```
  - To display the ETH-DM statistics collected for ETH-DM sessions for the local MEP **201** belonging to MA **ma2** and within MD **md2**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md2 maintenance-association ma2 local-mep 201
```
  - To display the ETH-DM statistics collected for ETH-DM sessions from local MEPs belonging to MA **ma3** and within MD **md3** to remote MEP **302**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md3 maintenance-association ma3 remote-mep 302
```

### Displaying ETH-DM Statistics and Frame Counts

**Purpose** Display ETH-DM statistics and ETH-DM frame counts.

By default, the **show oam ethernet connectivity-fault-management mep-statistics** command displays ETH-DM statistics and frame counts for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

- Action**
- To display the ETH-DM statistics and ETH-DM frame counts for MEPs in MA **ma1** and within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma1
```

- To display the ETH-DM statistics and ETH-DM frame counts for the local MEP 201 in MA **ma2** and within MD **md2**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display the ETH-DM statistics and ETH-DM frame counts for the local MEP in MD **md3** and within MA **ma3** that participates in an ETH-DM session with the remote MEP 302:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

## Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity

**Purpose** Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management mep-database** command displays CFM database information for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).



**NOTE:** At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

- Action**
- To display CFM database information (including ETH-DM frame counts) for all MEPs in MA **ma1** within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma1 maintenance-association ma1
```

- To display CFM database information (including ETH-DM frame counts) only for local MEP 201 in MA **ma1** within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display CFM database information (including ETH-DM frame counts) only for remote MEP 302 in MD **md3** within MA **ma3**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

## Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level

**Purpose** Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management interfaces** command displays CFM database information for MEPs attached to CFM-enabled Ethernet interfaces on the router or at a maintenance domain level. For Ethernet interfaces that support ETH-DM, any frame counts are also displayed when you specify the **detail** or **extensive** command option.



**NOTE:** At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

- Action**
- To display CFM database information (including ETH-DM frame counts) for all MEPs attached to CFM-enabled Ethernet interfaces on the router:  

```
user@host> show oam ethernet connectivity-fault-management interfaces detail
```
  - To display CFM database information (including ETH-DM frame counts) only for the MEPs attached to CFM-enabled router interface **ge-5/2/9.0**:  

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-5/2/9.0 detail
```
  - To display CFM database information (including ETH-DM frame counts) only for MEPs enclosed within CFM maintenance domains (MDs) at level **6**:  

```
user@host> show oam ethernet connectivity-fault-management interfaces level 6 detail
```

## Clearing ETH-DM Statistics and Frame Counts

**Purpose** Clear the ETH-DM statistics and ETH-DM frame counts.

By default, statistics and frame counts are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

- Action**
- To clear the ETH-DM statistics and ETH-DM frame counts for all MEPs attached to CFM-enabled interfaces on the router:  

```
user@host> clear oam ethernet connectivity-fault-management statistics
```
  - To clear the ETH-DM statistics and ETH-DM frame counts only for MEPs attached to the logical interface **ge-0/5/9.0**:  

```
user@host> clear oam ethernet connectivity-fault-management statistics ge-0/5/9.0
```

- Related Documentation**
- [clear oam ethernet connectivity-fault-management statistics on page 1275](#)
  - [show oam ethernet connectivity-fault-management delay-statistics on page 1716](#)
  - [show oam ethernet connectivity-fault-management interfaces on page 1724](#)
  - [show oam ethernet connectivity-fault-management mep-statistics on page 1753](#)
  - [show oam ethernet connectivity-fault-management mep-database on page 1742](#)
  - Ethernet Interfaces Feature Guide for Routing Devices*

## Displaying ETH-DM Statistics Only

**Purpose** Display ETH-DM statistics.

By default, the **show oam ethernet connectivity-fault-management delay-statistics** command displays ETH-DM statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

- Action**
- To display the ETH-DM statistics collected for MEPs belonging to MA **ma1** and within MD **md1**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics maintenance-domain ma1 maintenance-association ma1
```
  - To display the ETH-DM statistics collected for ETH-DM sessions for the local MEP **201** belonging to MA **ma2** and within MD **md2**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics maintenance-domain md2 maintenance-association ma2 local-mep 201
```
  - To display the ETH-DM statistics collected for ETH-DM sessions from local MEPs belonging to MA **ma3** and within MD **md3** to remote MEP **302**:  
  

```
user@host> show oam ethernet connectivity-fault-management delay-statistics maintenance-domain md3 maintenance-association ma3 remote-mep 302
```

**Related Documentation**

- [show oam ethernet connectivity-fault-management delay-statistics on page 1716](#)

---

## Displaying ETH-DM Statistics and Frame Counts

**Purpose** Display ETH-DM statistics and ETH-DM frame counts.

By default, the **show oam ethernet connectivity-fault-management mep-statistics** command displays ETH-DM statistics and frame counts for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

- Action**
- To display the ETH-DM statistics and ETH-DM frame counts for MEPs in MA **ma1** and within MD **md1**:  
  

```
user@host> show oam ethernet connectivity-fault-management mep-statistics maintenance-domain md1 maintenance-association ma1
```
  - To display the ETH-DM statistics and ETH-DM frame counts for the local MEP **201** in MA **ma2** and within MD **md2**:  
  

```
user@host> show oam ethernet connectivity-fault-management mep-statistics maintenance-domain md2 maintenance-association ma2 local-mep 201
```
  - To display the ETH-DM statistics and ETH-DM frame counts for the local MEP in MD **md3** and within MA **ma3** that participates in an ETH-DM session with the remote MEP **302**:  
  

```
user@host> show oam ethernet connectivity-fault-management mep-statistics maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

**Related Documentation**

- [show oam ethernet connectivity-fault-management mep-statistics on page 1753](#)

---

## Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity

**Purpose** Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management mep-database** command displays CFM database information for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).



**NOTE:** At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

- Action**
- To display CFM database information (including ETH-DM frame counts) for all MEPs in MA **ma1** within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma1 maintenance-association ma1
```

- To display CFM database information (including ETH-DM frame counts) only for local MEP **201** in MA **ma1** within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display CFM database information (including ETH-DM frame counts) only for remote MEP **302** in MD **md3** within MA **ma3**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

**Related Documentation**

- [show oam ethernet connectivity-fault-management mep-database on page 1742](#)

## Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level

**Purpose** Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the **show oam ethernet connectivity-fault-management interfaces** command displays CFM database information for MEPs attached to CFM-enabled Ethernet interfaces on the router or at a maintenance domain level. For Ethernet interfaces that support ETH-DM, any frame counts are also displayed when you specify the **detail** or **extensive** command option.



**NOTE:** At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

- Action**
- To display CFM database information (including ETH-DM frame counts) for all MEPs attached to CFM-enabled Ethernet interfaces on the router:

```
user@host> show oam ethernet connectivity-fault-management interfaces detail
```

- To display CFM database information (including ETH-DM frame counts) only for the MEPs attached to CFM-enabled router interface **ge-5/2/9.0**:

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-5/2/9.0 detail
```

- To display CFM database information (including ETH-DM frame counts) only for MEPs enclosed within CFM maintenance domains (MDs) at level 6:

```
user@host> show oam ethernet connectivity-fault-management interfaces level 6 detail
```

**Related  
Documentation**

- [show oam ethernet connectivity-fault-management interfaces on page 1724](#)

---

## Clearing ETH-DM Statistics and Frame Counts

**Purpose** Clear the ETH-DM statistics and ETH-DM frame counts.

By default, statistics and frame counts are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

**Action**

- To clear the ETH-DM statistics and ETH-DM frame counts for all MEPs attached to CFM-enabled interfaces on the router:

```
user@host> clear oam ethernet connectivity-fault-management statistics
```

- To clear the ETH-DM statistics and ETH-DM frame counts only for MEPs attached to the logical interface **ge-0/5.9.0**:

```
user@host> clear oam ethernet connectivity-fault-management statistics ge-0/5/9.0
```

**Related  
Documentation**

- [Managing ETH-DM Statistics and ETH-DM Frame Counts on page 679](#)

---

## Configuring MEP Interfaces

Before you can start an Ethernet frame delay measurement session across an Ethernet service, you must configure two MX Series routers to support ETH-DM.

To configure an Ethernet interface on a MX Series router to support ETH-DM:

1. On each router, configure two physical or logical Ethernet interfaces connected by a VLAN. The following configuration is typical for single-tagged logical interfaces:

```
[edit interfaces]
interface {
  ethernet-interface-name {
    vlan-tagging;
    unit logical-unit-number {
      vlan-id vlan-id; # Both interfaces on this VLAN
    }
  }
}
```

Both interfaces will use the same VLAN ID.

2. On each router, attach peer MEPs to the two interfaces. The following configuration is typical:

```
[edit protocols]
```



```

oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain md-name { # On both routers
        level number;
        maintenance-association ma-name { # On both routers
          continuity-check {
            interval 100ms;
            hold-interval 1;
          }
          mep mep-id { # Attach to VLAN interface
            auto-discovery;
            direction (up | down);
            interface interface-name;
            priority number;
          }
        }
      }
    }
  }
}

```

- Related Documentation**
- [Ethernet Frame Delay Measurements Overview on page 622](#)
  - [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*

## Ensuring That Distributed ppm Is Not Disabled

By default, the router's period packet management process (**ppm**) runs sessions distributed to the Packet Forwarding Engine in addition to the Routing Engine. This process is responsible for periodic transmission of packets on behalf of its various client processes, such as Bidirectional Forwarding Detection (BFD), and it also receives packets on behalf of client processes.

In addition, **ppm** handles time-sensitive periodic processing and performs such processes as sending process-specific packets and gathering statistics. With **ppm** processes running distributed on both the Routing Engine and the Packet Forwarding Engine, you can run such processes as BFD on the Packet Forwarding Engine.

**Distributed ppm Required for ETH-DM** Ethernet frame delay measurement requires that **ppm** remains distributed to the Packet Forwarding Engine. If **ppm** is not distributed to the Packet Forwarding Engines of both routers, ETH-DM PDU frame timestamps and ETH-DM statistics are not valid.

Before you start ETH-DM, you must verify that the following configuration statement is *NOT* present:

```

[edit]
routing-options {
  ppm {
    no-delegate-processing;
  }
}

```

If distributed **ppm** processing is disabled (as shown in the stanza above) on either router, you must re-enable it in order to use the ETH-DM feature.

#### **Procedure to Ensure that Distributed ppm is Not Disabled**

To ensure that distributed **ppm** is not disabled on a router:

1. Display the packet processing management (PPM) configuration to determine whether distributed **ppm** is disabled.

- In the following example, distributed **ppm** is enabled on the router. In this case, you do not need to modify the router configuration:

```
[edit]
user@host# show routing-options
ppm;
```

- In the following example, distributed **ppm** is disabled on the router. In this case, you must proceed to Step 2 to modify the router configuration:

```
[edit]
user@host show routing-options
ppm {
  no-delegate-processing;
}
```

2. Modify the router configuration to re-enable distributed **ppm** and restart the Ethernet OAM Connectivity Fault Management process *ONLY IF* distributed **ppm** is disabled (as determined in the previous step).

- a. Before continuing, make any necessary preparations for the possible loss of connectivity on the router.

Restarting the **ethernet-connectivity-fault-management** process has the following effect on your network:

- All connectivity fault management (CFM) sessions re-establish.
- All ETH-DM requests on the router terminate.
- All ETH-DM statistics and frame counts reset to 0.

- b. Modify the router configuration to re-enable distributed **ppm**. For example:

```
[edit]
user@host# delete routing-options ppm no-delegate-processing
```

- c. Commit the updated router configuration. For example:

```
[edit]
user@host# commit and-quit
commit complete
exiting configuration mode
```

- d. To restart the Ethernet OAM Connectivity-Fault-Management process, enter the **restart ethernet-connectivity-fault-management <gracefully | immediately | soft>** operational mode command. For example:

```
user@host> restart ethernet-connectivity-fault-management
Connectivity fault management process started, pid 9893
```

#### Related Documentation

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

## Enabling the Hardware-Assisted Timestamping Option

By default, Ethernet frame delay measurement uses software for timestamping transmitted and received ETH-DM frames. For Ethernet interfaces, you can optionally use hardware timing to assist in the timestamping of received ETH-DM frames to increase the accuracy of delay measurements.

Enabling hardware-assisted timestamping of received frames can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction.

To enable Ethernet frame delay measurement hardware assistance on the reception path, include the **hardware-assisted-timestamping** statement at the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring]** hierarchy level:

```
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      performance-monitoring {
        hardware-assisted-timestamping;
      }
    }
  }
}
```

**Related  
Documentation**

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- *Ethernet Interfaces Feature Guide for Routing Devices*

---

## Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling

Scaling is the ability of a system to handle an increasing amount of work and to continue to function well. Scaling can be used to refer to increasing capacity, workload, number of subscribers or sessions, hardware components and so on. Continuity check protocol is used for fault detection within a maintenance association. Maintenance end point (MEP) send continuity check messages (CCMs) periodically. The time between the transmissions of CCMs is known as the interval. The receiving MEP maintains a database of all MEPs in the maintenance association.

By default, continuity check messages (CCMs) are transmitted by the CPU of a line card, such as a Modular Port Concentrator (MPC). If the duration between transmissions of CCMs is low or if the CCMs for a specific line card scale, then we recommend that you delegate transmission of the CCMs to the forwarding ASIC (that is, to the hardware) by enabling inline transmission. Inline transmission enables the system to handle more connectivity fault management (CFM) sessions per line card. By enabling inline transmission of CCMs, you can achieve maximum scaling of CCMs.



**NOTE:** Starting from Junos OS Release 15.1F5, the supported CCM interval values for MPC7E are 100ms, 10ms, and 1s.

---

To enable inline transmission, perform the following steps:

1. In configuration mode, go to the **[edit protocols oam ethernet connectivity-fault-management performance-monitoring]** hierarchy level.

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
performance-monitoring
```

2. Delegate transmission of continuity check messages to hardware by enabling the **hardware-assisted-keepalives** option.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# set hardware-assisted-keepalives enable
```

To disable inline transmission, use the **hardware-assisted-keepalives disable** statement.

Related  
Documentation

- [hardware-assisted-keepalives on page 985](#)

## Using the monitor ethernet delay-measurement Command

After you have configured two MX Series routers to support ITU-T Y.1731 Ethernet frame delay measurement (ETH-DM), you can initiate a one-way or two-way Ethernet frame delay measurement session from the CFM maintenance association end point (MEP) on one of the routers to the peer MEP on the other router.

To start an ETH-DM session between the specified local MEP and the specified remote MEP, enter the **monitor ethernet delay-measurement** command at operational mode. The syntax of the command is as follows:

```
monitor ethernet delay-measurement
(one-way | two-way)
maintenance-domain md-name
maintenance-association ma-name
(remote-mac-address | mep remote-mep-id)
<count frame-count>
<wait interval-seconds>
<priority 802.1p value>
<size>
<no-session-id-tlv>
<xml>
```

For a one-way frame delay measurement, the command displays a runtime display of the number of 1DM frames sent from the initiator MEP during that ETH-DM session. One-way frame delay and frame delay variation measurements from an ETH-DM session are collected in a CFM database at the router that contains the receiver MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.

For a two-way frame delay measurement, the command displays two-way frame delay and frame delay variation values for each round-trip frame exchange during that ETH-DM session, as well as a runtime display of useful summary information about the session: average delay, average delay variation, best-case delay, and worst-case delay. Two-way frame delay and frame delay variation values measurements from an ETH-DM session are collected in a CFM database at the router that contains the initiator MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.



**NOTE:** Although you can trigger frame delay collection for up to 65,535 ETH-DM requests at a time, a router stores only the last 100 frame delay statistics per CFM session (pair of peer MEPs).

For a complete description of the **monitor ethernet delay-measurement** operational command, see the [CLI Explorer](#).

**Related Documentation**

- [monitor ethernet delay-measurement on page 1282](#)

---

## Managing ETH-LM Statistics

- [Displaying ETH-LM Statistics on page 690](#)
- [Clearing ETH-LM Statistics on page 691](#)

### Displaying ETH-LM Statistics

**Purpose** Display the ETH-LM statistics.

By default, the **show oam ethernet connectivity-fault-management loss-statistics maintenance-domain *md-name* maintenance-association *ma-name*** command displays ETH-LM statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

The following list consists of the CFM-related operational mode commands that have been enhanced to display ETH-LM statistics:

- The **show oam ethernet connectivity-fault-management interfaces detail** command is enhanced to display ETH-DM and ETH-LM statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).
- The **show oam ethernet connectivity-fault-management mep-statistics** command is enhanced to display ETH-DM and ETH-LM statistics and frame counts for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).
- The **show oam ethernet connectivity-fault-management mep-database** command is enhanced to display ETH-DM and ETH-LM frame counters for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

**Action**

- To display the ETH-LM statistics for all MEPs attached to CFM-enabled interfaces on the router:

```
user@host> show oam ethernet connectivity-fault-management loss-statistics
```

- To display the ETH-DM statistics collected for MEPs belonging to MA **ma1** and within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management delay-statistics  
maintenance-domain md1 maintenance-association ma1
```

- To display the ETH-DM statistics and ETH-DM frame counts for MEPs in MA **ma1** and within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics  
maintenance-domain md1 maintenance-association ma1
```

- To display CFM database information (including ETH-DM frame counts) for all MEPs in MA **ma1** within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md1 maintenance-association ma1
```

## Clearing ETH-LM Statistics

**Purpose** Clear the ETH-LM statistics.

By default, statistics are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

- Action**
- To clear the ETH-LM statistics for all MEPs attached to CFM-enabled interfaces on the router:

```
user@host> clear oam ethernet connectivity-fault-management loss-statistics
```

**Related Documentation**

- [Managing ETH-DM Statistics and ETH-DM Frame Counts on page 679](#)

## Managing Continuity Measurement Statistics

- [Displaying Continuity Measurement Statistics on page 691](#)
- [Clearing Continuity Measurement Statistics on page 691](#)

## Displaying Continuity Measurement Statistics

**Purpose** Display continuity measurement.

The **show oam ethernet connectivity-fault-management delay-statistics maintenance-domain md1 maintenance-association ma1** command is enhanced to display continuity measurement statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

- Action**
- To display the ETH-DM statistics collected for MEPs belonging to MA **ma1** and within MD **md1**:

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md1 maintenance-association ma1
```

## Clearing Continuity Measurement Statistics

**Purpose** Clear the continuity measurement statistics

By default, statistics are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

- Action**
- To clear the continuity measurement statistics for all MEPs attached to CFM-enabled interfaces on the router:

```
user@host> clear oam ethernet connectivity-fault-management continuity-measurement
maintenance-domain md-name maintenance-association ma-name local-mep local-mep-id
remote-mep remote-mep-id
```

- Related Documentation
- [clear oam ethernet connectivity-fault-management continuity-measurement on page 1271](#)
  - *Ethernet Interfaces Feature Guide for Routing Devices*
  - [show oam ethernet connectivity-fault-management delay-statistics on page 1716](#)

---

## Configuring the Failure Notification Protocol

This topic describes how to configure the Ethernet Operations, Administration, and Maintenance (OAM) Failure Notification Protocol (FNP) on MX Series routers. The FNP detects link failures in a Carrier Ethernet network and broadcasts FNP messages when a failure occurs to all nodes affected by the link failure. To configure FNP functionality, include the **fnp** statement at the **[edit protocols oam ethernet]** hierarchy level:

```
[edit protocols oam]
ethernet {
  fnp {
    interval <100ms | 1s | 10s | 1m | 10m>;
    loss-threshold number
    interface interface name {
      domain-id domain-id
    }
  }
}
```

The **interval** statement specifies the time between the transmission of FNP messages. You can specify 10 minutes (10m), 1 minute (1m), 10 seconds (10s), 1 second (1s), and 100 milliseconds (100ms). The **loss-threshold** statement specifies how many FNP messages can be lost before the FNP message is considered aged out and flushed. You must include the **interface *interface-name*** statement with the **domain-id *domain-id*** statement. The **domain-id** statement specifies a domain ID for the route. FNP messages can be received and processed on MX Series routers, but generating FNP messages is not supported.

The **show oam ethernet fnp interface**, **show oam ethernet fnp status**, and **show oam ethernet fnp messages** operational commands display the configured information.

FNP can be enabled only on logical interfaces that are part of a VPLS routing instance, and none of the logical interfaces in the VPLS routing instance should have CCM configured. FNP can be enabled on only one logical interface per physical interface.

- Related Documentation
- [connectivity-fault-management on page 914](#)
  - [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)



## Ethernet Alarm Indication Signal (ETH-AIS) Function Overview

Ethernet alarm indication signal (ETH-AIS) function enables a service provider deploying an Ethernet service to determine whether a connectivity fault exists at the provider's domain level or at a level below. When the fault occurs at the provider's domain level, the service provider addresses the fault, and when the fault occurs at a level below, the provider can either ignore the fault or contact the relevant authorities to address the fault.

The following sections explain ETH-AIS, few use cases which determine when to generate and propagate ETH-AIS packets, and associated terms in detail:

- [Understanding ETH-AIS in a Maintenance Domain on page 693](#)
- [Fault Detection in a Maintenance Domain on page 693](#)
- [Terms Defined on page 695](#)

### Understanding ETH-AIS in a Maintenance Domain

ITU-T developed Y.1731 as a recommendation for Operation, Administration, and Maintenance (OAM) functions and mechanisms for Ethernet-based networks, including OAM functions such as ETH-AIS, Ethernet locked signal (ETH-LCK), Ethernet test signal (ETH-Test), Ethernet automatic protection switching (ETH-APS), Ethernet maintenance communication channel (ETH-MCC), Ethernet experimental OAM (ETH-EXP), Ethernet vendor-specific OAM (ETH-VSP), and performance monitoring. For information about maintenance domain and related terms, see ["Terms Defined" on page 695](#).

According to the Y.1731 standards, a server MEP is a combined function of the server layer termination function and the server Ethernet services layer adaptation function. The server MEP notifies the Ethernet services (ETH) layer MEPs when it detects a failure. The server layer termination function then runs the OAM mechanisms specific to the server layer and the alarms are suppressed at the server layer by ETH-AIS.

Note that ETH-AIS is not applicable to Spanning Tree Protocol (STP) networks.

ETH-AIS enables you to suppress alarms when a fault condition is detected. Using ETH-AIS, a service provider can differentiate between faults at different levels.

ETH-AIS provides many advantages that include:

- Service providers need not raise alarms if there are lower-level failures.
- Service providers can provide a refund to their subscribers or avail a refund from their Internet provider based on service unavailability.

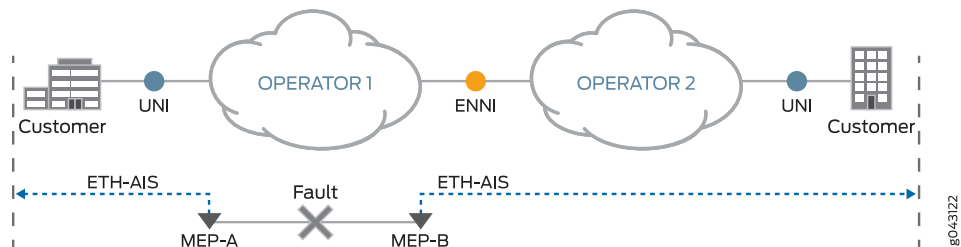
MX Series routers support ITU-T Y.1731 ETH-AIS to provide fault management for service providers who provide carrier Ethernet services using IEEE 802.1ag standard.

### Fault Detection in a Maintenance Domain

In the scenario depicted in Figure 1 on page xyz, you have a service provider level and a customer level. Two service providers—*Operator-1* and *Operator-2*—are considered for

illustration purposes. Assume that a fault occurs in Operator-1 maintenance domain-level that has MEP-A and MEP-B at its maintenance domain-level boundaries. To notify the faults to a network management system and to avoid notification of alarms from the customer level for the same fault, MEP-A and MEP-B transmit an alarm indication signal (AIS) on opposite directions, thereby signaling the higher levels and the Operator-2 network about the fault, so that the alarms are suppressed.

Signaling is achieved through transmission and propagation of AIS protocol data units (PDUs). You must enable AIS explicitly on all the MEPs at the service provider level. A MEP that is configured to issue frames with ETH-AIS information is generally at the server layer and continues to transmit periodic frames with ETH-AIS information until the defect condition is cleared. When a client MEP receives the ETH-AIS frames, it suppresses loss-of-continuity alarms associated with its peer MEPs.



Note that in the absence of AIS, a client MEP resumes generating loss-of-continuity alarms when it detects the loss-of-continuity defect conditions from its server layer.

For point-to-point Ethernet services layer connectivity, a MEP has only one peer MEP. Therefore, there is no ambiguity regarding the peer MEP for which the MEP should suppress alarms when it receives the ETH-AIS information.

For multipoint Ethernet services layer connectivity, a MEP that receives ETH-AIS information cannot determine the exact MEP that encountered the fault and, therefore, cannot isolate the exact peer MEP to suppress the alarms. To avoid this scenario, Y.1731 recommends suppressing alarms for all peer MEPs in the same domain level irrespective of connectivity status in a multipoint Ethernet services layer connectivity setup.

Table 60 on page 694 lists the operational mode commands that you can use in a maintenance domain to check the various parameters pertaining to a MEP.

**Table 60: Operational Mode Commands**

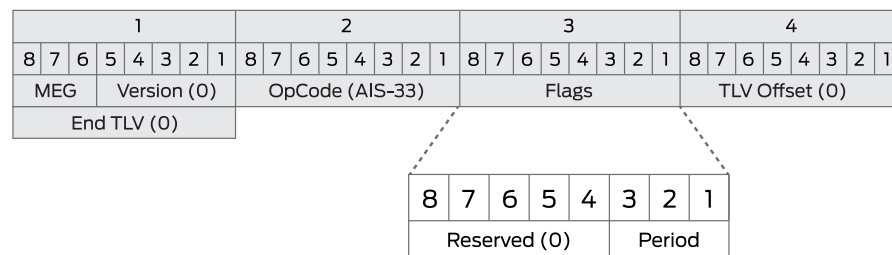
To Check	Operational Mode Commands
Whether the AIS configuration is configured correctly on a CFM MEP.	<code>show protocols oam ethernet connectivity-fault-management action-profile</code>
Statistics of AIS frames.	<code>show oam ethernet connectivity-fault-management interfaces detail</code>  <code>show oam ethernet connectivity-fault-management mep-statistics maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> remote-mep <i>mep-id</i> local-mep <i>mep-id</i></code>

Table 60: Operational Mode Commands (*continued*)

To Check	Operational Mode Commands
Whether any event has occurred that triggered AIS.	<code>show oam ethernet connectivity-fault-management mep-database maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> remote-mep <i>mep-id</i> local-mep <i>mep-id</i></code>
Status of CFM sessions for faults that trigger AIS on the MEP.	<code>show oam ethernet connectivity-fault-management interfaces detail</code>

## Terms Defined

- AIS transmission—A MEP upon detecting a defect condition transmits AIS frames in a direction opposite to its peer MEPs. The periodicity of AIS frames transmission is on the basis of the AIS transmission period. An AIS transmission period of 1 second is recommended. The first AIS frame must always be transmitted immediately following the detection of a defect condition.
- AIS reception—Upon receiving an AIS frame, a MEP examines it to ensure that the frame's maintenance domain level is the same as its own maintenance domain level. The *period* field in the frame indicates the period at which the AIS frames can be expected. When a MEP receives an AIS frame, it detects the defect condition. After detection, when no AIS frames are received within an interval of 3.5 times—the AIS transmission period indicated in the AIS frames received—the MEP clears the AIS defect condition. When the AIS condition is cleared and defects still exist, then the MEPs continue to report alarms.
- AIS PDU format—The fields of the AIS PDU format are:



- MEG Level—Also called the maintenance domain level, it is a 3-bit field that is used to carry the maintenance domain level of the client MEG.
- Version—Value is always 0.
- OpCode—Value for this PDU type is AIS (33).
- Flags—The first five bits are reserved and are set to 0. The 3-bit information element carried in the three least significant bits are referred to as the period that contains the value of AIS transmission periodicity as illustrated in [Table 61 on page 696](#):

Table 61: AIS Transmission Periodicity

Flags [3:1]	Period Value	Comments
000-011	Invalid value	Invalid value for AIS
100	1s	1 frame per second
101	Invalid value	Invalid value for AIS
110	1 min	1 frame per minute
111	Invalid value	Invalid value for AIS

e. TLV offset—Set to 0.

f. End TLV—All-zeroes octet value.

- Server layer and client layer—These layers are part of the ITU-T Recommendation G.805 transport network functional model. This model is based on the concept of layering within a transport network. A transport network is divided into several independent transport layer networks that have a client-server association between adjacent layer networks.
- Maintenance domain—To enable connectivity fault management (CFM) on an Ethernet interface, maintenance domains, maintenance associations, and maintenance end points (MEPs) are created and configured in a network. You can configure up to eight maintenance domain levels in a network. Each maintenance domain level is a part of the network where the connectivity issues can be monitored and corrected. Provider domain and customer domain are some examples for maintenance domains. Each maintenance domain has a maintenance association. Each maintenance association includes MEPs and maintenance intermediate points (MIPs) in that domain. The MEPs are located at the boundary of the domain and the MIPs are located within the domain. MEPs generate and transmit continuity check messages (CCMs) at configured intervals to the entire maintenance association to check the connectivity in the network.
- Ethernet services (ETH) layer—A layer in the metro Ethernet network model, where this layer is responsible for the OAM services that are required to support the Ethernet services in the network.

**Related  
Documentation**

- [Configuring ETH-AIS on a CFM MEP on page 696](#)

## Configuring ETH-AIS on a CFM MEP

MX Series routers support ITU-T Y.1731 Ethernet alarm indication signal (ETH-AIS) function to provide fault management for service providers. ETH-AIS enables the service provider to suppress alarms when a fault condition is detected.

The following points are to be noted when ETH-AIS is configured in a maintenance domain:

- Transmitting or receiving of AIS on a MEP does not override the **lowest-priority-defect** statement configured at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id]` hierarchy level. Therefore, alarms are reported according to the defect priority configured.
- Alarms are reported even when the higher domain levels exchange CCMs at a faster rate than the lower domain levels.
- Maintenance association intermediate point (MIP) is transparent to ETH-AIS frames—that is, the MIPs do not perform any action in response to ETH-AIS frames.
- When the service provider requests the MEP to generate an AIS for a lower level or for the same level, the request is rejected.
- AIS generation is stopped when the MEP clears the remote MEP within the maintenance association.
- When the **auto-discovery** statement is enabled for a MEP, the remote MEP information is cleared after the configured hold interval expires.

The following tasks explain how to enable ETH-AIS in a maintenance domain, configure an action to be taken when a defect is detected, and to attach the action profile to a CFM MEP:

1. [Configuring an Action Profile on page 697](#)
2. [Configuring an Action to Be Taken When an AIS Alarm Is Detected on page 698](#)
3. [Attaching the Action Profile to a CFM MEP on page 699](#)

## Configuring an Action Profile

To configure an action profile for ETH-AIS:

1. Go to the `[edit protocols oam ethernet connectivity-fault-management]` hierarchy level.  

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
```
2. Configure an action profile to use when one or more remote MEPs are down.  

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# edit action-profile action-profile-name
```
3. Configure an event that needs to be monitored.  

```
[edit protocols oam ethernet connectivity-fault-management action-profile
action-profile-name]
user@host# edit event
```
4. Configure the defect condition that generates an alarm indication signal.  

```
[edit protocols oam ethernet connectivity-fault-management action-profile
action-profile-name event]
user@host# edit ais-trigger-condition
```

5. Configure the **adjacency-loss** statement to inform the operator when the physical connectivity is lost between the peer MEPs.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name event ais-trigger-condition]  
user@host# set adjacency-loss
```

6. Configure the **all-defects** statement to inform the operator that all possible defects must be considered to raise the alarm indication signal.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name event ais-trigger-condition]  
user@host# set all-defects
```

7. Configure the **cross-connect-ccm** statement to inform the operator when cross-connect continuity check messages (CCMs) are received by the MEP and to raise an alarm indication signal in response.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name event ais-trigger-condition]  
user@host# set cross-connect-ccm
```

8. Configure the **erroneous-ccm** statement to inform the operator when CCMs with unexpected MEP ID or maintenance domain level are received by the MEP and an AIS alarm is raised in response.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name event ais-trigger-condition]  
user@host# set erroneous-ccm
```

9. Configure the **receive-ais** statement to inform the operator that an AIS message has been received from the peer MEP in its own maintenance level.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name event ais-trigger-condition]  
user@host# set receive-ais
```

## Configuring an Action to Be Taken When an AIS Alarm Is Detected

Configure an action to be taken when an AIS alarm is detected.

1. Go to the **[edit protocols oam ethernet connectivity-fault-management action-profile *action-profile-name* action]** hierarchy level.

```
[edit]  
user@host# edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name action
```

2. Configure the **log-and-generate-ais** statement to log the event that generated the AIS message.

```
[edit protocols oam ethernet connectivity-fault-management action-profile  
  action-profile-name action]  
user@host# edit log-and-generate-ais
```

3. Configure the interval between AIS messages that are to be received by the MEP as 1 minute or 1 second.

```
[edit protocols oam ethernet connectivity-fault-management action-profile
  action-profile-name action log-and-generate-ais]
user@host# set interval (1m | 1s)
```

4. Configure the server maintenance domain level range of the MEP from 1 through 7.

```
[edit protocols oam ethernet connectivity-fault-management action-profile
  action-profile-name action log-and-generate-ais]
user@host# set level level
```

5. Configure the 802.1p priority of the AIS packet from 1 through 7.

```
[edit protocols oam ethernet connectivity-fault-management action-profile
  action-profile-name action log-and-generate-ais]
user@host# set priority level
```

## Attaching the Action Profile to a CFM MEP

After configuring an event and an action to be monitored in an action profile, you must attach the action profile to a CFM MEP.

1. Go to the **[edit protocols oam ethernet connectivity-fault-management]** hierarchy level.

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
```

2. Configure the maintenance domain with a name.

```
[edit protocols oam ethernet connectivity-fault-management]
user@host# edit maintenance-domain md-name
```

3. Configure the maintenance domain with a client maintenance entity group (MEG) level or maintenance association level—the level which the client layer maintenance association intermediate point (MIPs) and the MEPs exist—from 0 through 7.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name]
user@host# edit level level
```



**NOTE:** You cannot configure a maintenance domain level that is lower than or equal to the maintenance association level that it is associated with.

4. Configure the maintenance association.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name]
user@host# edit maintenance-association ma-name
```

5. Configure the continuity check that is performed on all the MEPs in a domain level by sending CCMs with an interval between two CCMs—100 milliseconds, 10 milliseconds, 1 second, 10 seconds, 1 minute, or 10 minutes—and the number of CCMs that are to be lost before marking a MEP as down.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name]
user@host# set continuity-check interval (100ms | 10m | 10ms | 1m | 1s)
```

```
user@host# set continuity-check loss-threshold value
```

6. Configure the MEP with an identifier from 1 through 8192.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name]
user@host# set mep mep-id
```

7. Attach the configured action profile to the MEP.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id]
user@host# set action-profile action-profile-name
```

8. Configure the interface of the MEP over which the CCMs are transmitted.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id]
user@host# set interface interface-name
```

9. Configure the direction for the CCMs to travel to the next MEP as up or down.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id]
user@host# set direction (down | up)
```

10. Configure the 802.1p priority for the CCMs and link-trace packet from 0 through 7.

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id]
user@host# set priority priority-value
```

#### Related Documentation

- [Ethernet Alarm Indication Signal \(ETH-AIS\) Function Overview on page 693](#)

## Example: Configuring One-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces

This example uses two MX Series routers: **MX-1** and **MX-2**. The configuration creates a CFM down MEP session on a VLAN-tagged logical interface connecting the two (**ge-5/2/9** on Router **MX-1** and **ge-0/2/5** on Router **MX-2**).



**NOTE:** These are not complete router configurations.

Configuration on Router **MX-1**:

```
[edit]
interfaces {
  ge-5/2/9 {
    vlan-tagging;
    unit 0 {
      vlan-id 512;
    }
  }
}
protocols {
```



```

oam {
  ethernet {
    connectivity-fault-management {
      traceoptions {
        file eoam_cfm.log size 1g files 2 world-readable;
        flag all;
      }
      linktrace {
        path-database-size 255;
        age 10s;
      }
      maintenance-domain md6 {
        level 6;
        maintenance-association ma6 {
          continuity-check {
            interval 100ms;
            hold-interval 1;
          }
          mep 201 {
            interface ge-5/2/9.0;
            direction down;
            auto-discovery;
          }
        }
      }
    }
  }
}

```

Configuration on Router **MX-2**:

```

[edit]
interfaces {
  ge-0/2/5 {
    vlan-tagging;
    unit 0 {
      vlan-id 512;
    }
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        linktrace {
          path-database-size 255;
          age 10s;
        }
        maintenance-domain md6 {
          level 6;
          maintenance-association ma6 {

```

```

continuity-check {
    interval 100ms;
    hold-interval 1;
}
mep 101 {
    interface ge-0/2/5.0;
    direction down;
    auto-discovery;
}
}
}
}
}
}
}
}
}
}

```

From Router **MX-2**, start a one-way delay measurement to Router **MX-1**.

```

user@MX-2> monitor ethernet delay-measurement one-way mep 201 maintenance-domain md6
maintenance-association ma6 count 10
One-way ETH-DM request to 00:90:69:0a:43:94, Interface ge-0/2/5.0
1DM Frames sent : 10
--- Delay measurement statistics ---
Packets transmitted: 10
Average delay: NA, Average delay variation: NA
Best case delay: NA, Worst case delay: NA

```

The counters are displayed as part of the local MEP database on Router **MX-2**.

```

user@MX-2> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-domain ma6
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 101, Direction: down, MAC address: 00:90:69:0a:48:57
Auto-discovery: enabled, Priority: 0
Interface name: ge-0/2/5.0, Interface status: Active, Link status: Up
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : no
Statistics:
  CCMs sent                                  : 1590
  CCMs received out of sequence              : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received               : 0
  Valid out-of-order LBRs received           : 0
  LBRs received with corrupted data          : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                             : 0
  LTRs sent                                  : 0
  LTRs received                             : 0
  Sequence number of next LTM request        : 0
  1DMs sent                                  : 10
  Valid 1DMs received                       : 0
  Invalid 1DMs received                     : 0
  DMMs sent                                  : 0

```

```

DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0
Remote MEP count: 1
Identifier  MAC address      State  Interface
201        00:90:69:0a:43:94  ok    ge-0/2/5.0

```

The remote MEP database statistics are available on Router **MX-1**.

```

user@MX-1> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 201, Direction: down, MAC address: 00:90:69:0a:43:94
Auto-discovery: enabled, Priority: 0
Interface name: ge-5/2/9.0, Interface status: Active, Link status: Up
Defects:
Remote MEP not receiving CCM : no
Erroneous CCM received : no
Cross-connect CCM received : no
RDI sent by some MEP : no
Statistics:
CCMs sent : 1572
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
IDMs sent : 0
Valid IDMs received : 10
Invalid IDMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0
Remote MEP count: 1
Identifier  MAC address      State  Interface
101        00:90:69:0a:48:57  ok    ge-5/2/9.0

```

The remote Router **MX-1** should also collect the delay statistics (up to 100 per session) for display with **mep-statistics** or **delay-statistics**.

```

user@MX-1> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md6
MEP identifier: 201, MAC address: 00:90:69:0a:43:94
Remote MEP count: 1
CCMs sent : 3240
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0

```

```

LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
1DMs sent : 0
Valid 1DMs received : 10
Invalid 1DMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0

```

Remote MEP identifier: 101

Remote MAC address: 00:90:69:0a:48:57

Delay measurement statistics:

Index	One-way delay (usec)	Two-way delay (usec)
1	370	
2	357	
3	344	
4	332	
5	319	
6	306	
7	294	
8	281	
9	269	
10	255	

Average one-way delay : 312 usec

Average one-way delay variation: 11 usec

Best case one-way delay : 255 usec

Worst case one-way delay : 370 usec

user@MX-1> show oam ethernet connectivity-fault-management delay-statistics  
maintenance-domain md6

MEP identifier: 201, MAC address: 00:90:69:0a:43:94

Remote MEP count: 1

Remote MAC address: 00:90:69:0a:48:57

Delay measurement statistics:

Index	One-way delay (usec)	Two-way delay (usec)
1	370	
2	357	
3	344	
4	332	
5	319	
6	306	
7	294	
8	281	
9	269	
10	255	

Average one-way delay : 312 usec

Average one-way delay variation: 11 usec

Best case one-way delay : 255 usec



**NOTE:** When two systems are close to each other, their one-way delay values are very high compared to their two-way delay values. This is because one-way delay measurement requires the timing for the two systems to be synchronized at a very granular level and MX Series routers do not support this granular synchronization. However, two-way delay measurement does not require synchronized timing, making two-way delay measurements more accurate.

#### Related Documentation

- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Frame Delay Measurements](#)
- [Configuring MEP Interfaces to Support ETH-DM](#)
- [Triggering an ETH-DM Session on page 734](#)
- [Viewing ETH-DM Statistics on page 735](#)
- [Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 705](#)
- [Configuring ETH-DM with Untagged Interfaces on page 709](#)

## Example: Configuring Two-Way Ethernet Frame Delay Measurements with Single-Tagged Interfaces

This example uses two MX Series routers: **MX-1** and **MX-2**. The configuration creates a CFM down MEP session on a VLAN-tagged logical interface connecting the two (**ge-5/2/9** on Router **MX-1** and **ge-0/2/5** on Router **MX-2**).



**NOTE:** These are not complete router configurations.

Configuration on Router **MX-1**:

```
[edit]
interfaces {
  ge-5/2/9 {
    vlan-tagging;
    unit 0 {
      vlan-id 512;
    }
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        linktrace {
```

```
        path-database-size 255;
        age 10s;
    }
    maintenance-domain md6 {
        level 6;
        maintenance-association ma6 {
            continuity-check {
                interval 100ms;
                hold-interval 1;
            }
            mep 201 {
                interface ge-5/2/9.0;
                direction down;
                auto-discovery;
            }
        }
    }
}
}
```

Configuration on Router MX-2:

```
[edit]
interfaces {
    ge-0/2/5 {
        vlan-tagging;
        unit 0 {
            vlan-id 512;
        }
    }
}
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                traceoptions {
                    file eoam_cfm.log size 1g files 2 world-readable;
                    flag all;
                }
                linktrace {
                    path-database-size 255;
                    age 10s;
                }
            }
            maintenance-domain md6 {
                level 6;
                maintenance-association ma6 {
                    continuity-check {
                        interval 100ms;
                        hold-interval 1;
                    }
                    mep 101 {
                        interface ge-0/2/5.0;
                        direction down;
                        auto-discovery;
                    }
                }
            }
        }
    }
}
```

```

    }
  }
}

```

From Router **MX-1**, start a two-way delay measurement to Router **MX-2**.

```

user@MX-1> monitor ethernet delay-measurement two-way mep 101 maintenance-domain md6
maintenance-association ma6 count 10

```

```

Two-way ETH-DM request to 00:90:69:0a:48:57, Interface ge-5/2/9.0
DMR received from 00:90:69:0a:48:57 Delay: 100 usec Delay variation: 0 usec
DMR received from 00:90:69:0a:48:57 Delay: 92 usec Delay variation: 8 usec
DMR received from 00:90:69:0a:48:57 Delay: 92 usec Delay variation: 0 usec
DMR received from 00:90:69:0a:48:57 Delay: 111 usec Delay variation: 19 usec
DMR received from 00:90:69:0a:48:57 Delay: 110 usec Delay variation: 1 usec
DMR received from 00:90:69:0a:48:57 Delay: 119 usec Delay variation: 9 usec
DMR received from 00:90:69:0a:48:57 Delay: 122 usec Delay variation: 3 usec
DMR received from 00:90:69:0a:48:57 Delay: 92 usec Delay variation: 30 usec
DMR received from 00:90:69:0a:48:57 Delay: 92 usec Delay variation: 0 usec
DMR received from 00:90:69:0a:48:57 Delay: 108 usec Delay variation: 16 usec

```

```

--- Delay measurement statistics ---

```

```

Packets transmitted: 10, Valid packets received: 10
Average delay: 103 usec, Average delay variation: 8 usec
Best case delay: 92 usec, Worst case delay: 122 usec

```

The counters are displayed as part of the MEP database on Router **MX-1** maintenance domain **MD6**.

```

user@MX-1> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6

```

```

Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 201, Direction: down, MAC address: 00:90:69:0a:43:94
Auto-discovery: enabled, Priority: 0
Interface name: ge-5/2/9.0, Interface status: Active, Link status: Up
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : no
Statistics:
  CCMs sent                                  : 894
  CCMs received out of sequence              : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received               : 0
  Valid out-of-order LBRs received           : 0
  LBRs received with corrupted data          : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                             : 0
  LTRs sent                                  : 0
  LTRs received                             : 0
  Sequence number of next LTM request        : 0
  1DMs sent                                  : 0
  Valid 1DMs received                       : 0

```

```

Invalid 1DMs received           : 0
DMMs sent                      : 10
DMRs sent                      : 0
Valid DMRs received            : 10
Invalid DMRs received          : 0
Remote MEP count: 1
Identifier    MAC address      State    Interface
101          00:90:69:0a:48:57  ok     ge-5/2/9.0

```

The collected MEP statistics are saved (up to 100 per remote MEP or per CFM session) and displayed as part of the MEP statistics on Router **MX-1**.

```

user@MX-1> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md6

```

```

MEP identifier: 201, MAC address: 00:90:69:0a:43:94

```

```

Remote MEP count: 1
CCMs sent                      : 3154
CCMs received out of sequence  : 0
LBMs sent                      : 0
Valid in-order LBRs received   : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent                     : 0
LTMs sent                     : 0
LTMs received                 : 0
LTRs sent                     : 0
LTRs received                 : 0
Sequence number of next LTM request : 0
1DMs sent                    : 0
Valid 1DMs received          : 0
Invalid 1DMs received        : 0
DMMs sent                    : 10
DMRs sent                    : 0
Valid DMRs received          : 10
Invalid DMRs received        : 0

```

```

Remote MEP identifier: 101

```

```

Remote MAC address: 00:90:69:0a:48:57

```

```

Delay measurement statistics:

```

Index	One-way delay (usec)	Two-way delay (usec)
1		100
2		92
3		92
4		111
5		110
6		119
7		122
8		92
9		92
10		108

```

Average two-way delay          : 103 usec
Average two-way delay variation: 8 usec
Best case two-way delay        : 92 usec
Worst case two-way delay       : 122 usec

```

The collected delay statistics are also saved (up to 100 per session) and displayed as part of the MEP delay statistics on Router **MX-1**.



```
user@MX-1> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md6
```

```
MEP identifier: 201, MAC address: 00:90:69:0a:43:94
```

```
Remote MEP count: 1
```

```
Remote MAC address: 00:90:69:0a:48:57
```

```
Delay measurement statistics:
```

Index	One-way delay	Two-way delay (usec)	(usec)
1		100	
2		92	
3		92	
4		111	
5		110	
6		119	
7		122	
8		92	
9		92	
10		108	

```
Average two-way delay      : 103 usec
```

```
Average two-way delay variation: 8 usec
```

```
Best case two-way delay    : 92 usec
```

```
Worst case two-way delay   : 122 usec
```

#### Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet Frame Delay Measurements*
- *Configuring MEP Interfaces to Support ETH-DM*
- [Triggering an ETH-DM Session on page 734](#)
- [Viewing ETH-DM Statistics on page 735](#)
- [Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 700](#)
- [Configuring ETH-DM with Untagged Interfaces on page 709](#)

## Example: Configuring Ethernet Frame Delay Measurements with Untagged Interfaces

Ethernet frame delay measurements are supported on untagged interfaces. All commands are the same as for tagged interfaces. Only the configurations are different. This section shows the untagged interface configurations for Routers **MX-1** and **MX-2**.



**NOTE:** These are not complete router configurations.

Untagged interface configuration for Router **MX-1**.

```
[edit]
interfaces {
  ge-5/0/0 {
    unit 0;
  }
  ge-5/2/9 {
    unit 0;
  }
}
```

```
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        linktrace {
          path-database-size 255;
          age 10s;
        }
        maintenance-domain md6 {
          level 6;
          maintenance-association ma6 {
            continuity-check {
              interval 100ms;
              hold-interval 1;
            }
            mep 201 {
              interface ge-5/0/0;
              direction down;
              auto-discovery;
            }
          }
        }
      }
    }
  }
}
```

Untagged interface configuration for Router **MX-2**.

```
[edit]
interfaces {
  ge-0/2/2 {
    unit 0;
  }
  ge-0/2/5 {
    unit 0;
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        linktrace {
          path-database-size 255;
          age 10s;
        }
        maintenance-domain md6 {
```

```

level 6;
maintenance-association ma6 {
    continuity-check {
        interval 100ms;
        hold-interval 1;
    }
    mep 101 {
        interface ge-0/2/2;
        direction down;
        auto-discovery;
    }
}
}
}
}
}
}
}

```

#### Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet Frame Delay Measurements*
- *Configuring MEP Interfaces to Support ETH-DM*
- [Triggering an ETH-DM Session on page 734](#)
- [Viewing ETH-DM Statistics on page 735](#)
- [Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 700](#)
- [Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 705](#)

### Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs

This example illustrates how to configure Ethernet frame loss measurement (ETH-LM) for single-tagged Loss Measurement Message (LMM)/Loss Measurement Reply (LMR) protocol data units (PDUs). By configuring ETH-LM, you can measure the Ethernet frame loss that occur in your network.

- [Requirements on page 711](#)
- [Overview and Topology on page 712](#)
- [Configuration on page 712](#)
- [Verification on page 721](#)

#### Requirements

This example uses the following hardware and software components:

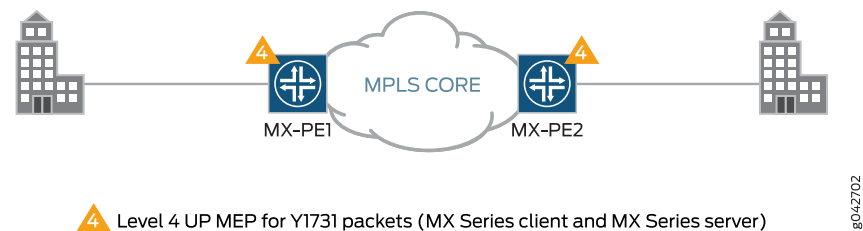
- Two MX Series 3D Universal Edge Routers with Rev-B Dense Port Concentrators (DPCs)
- Junos OS Release 14.2 or later

## Overview and Topology

Junos OS supports Ethernet frame loss measurement (ETH-LM) between maintenance association end points (MEPs) configured on Ethernet physical or logical interfaces on Rev-B Dense Port Concentrators (DPCs) in MX Series routers. Additionally, the Y.1731 functionality supports ETH-LM only for an end-to-end connection that uses Virtual Private Wire Service (VPWS). This example illustrates how to configure ETH-LM for single-tagged LMM/LMR PDUs with input and output VLAN map configured as **swap**.

Figure 48 on page 712 shows the topology used in this example. VPWS service is configured between two MX Series routers, MX-PE1 and MX-PE2.

Figure 48: VPWS Service Configured Between Two MX Series Routers



MX-PE1 router has two Ethernet interfaces, **ge-5/0/4** and **ge-5/1/9**. Virtual LAN (VLAN) is configured on **ge-5/0/4** and MPLS is configured on the **ge-5/1/9** interface. The **ge-5/0/4.11** interface is used to configure the Layer 2 virtual circuit with MX-PE2 router. The UP MEP, **mep 2**, is attached to the **ge-5/0/4.11** interface. The three-color policer firewall filter is also configured for the MX-PE1 router.

Similarly, MX-PE2 router has two Ethernet interfaces, **ge-8/0/8** and **ge-8/0/9**. Virtual LAN (VLAN) is configured on **ge-8/0/8** and MPLS is configured on the **ge-8/0/9** interface. The **ge-8/0/8.11** interface is used to configure the Layer 2 virtual circuit with MX-PE1 router. The UP MEP, **mep 1**, is attached to the **ge-8/0/8.11** interface. The three-color policer firewall filter is also configured for the MX-PE2 router.

## Configuration

### CLI Quick Configuration

To quickly configure ETH-LM for single-tagged LMM/LMR PDUs, copy the following commands, remove any line breaks, and then paste the commands into the CLI of each device.

On Router PE1:

```
[edit]
set interfaces ge-5/0/4 encapsulation flexible-ethernet-services
set interfaces ge-5/0/4 unit 11 encapsulation vlan-ccc
set interfaces ge-5/0/4 unit 11 layer2-policer input-three-color abc
set interfaces ge-5/0/4 unit 11 family ccc
set interfaces ge-5/1/9 enable
set interfaces ge-5/1/9 unit 0 family inet address 12.1.1.1/24
set interfaces ge-5/1/9 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 4.4.4.4/32
```

```

set interfaces ge-5/0/4 flexible-vlan-tagging
set interfaces ge-5/0/4 unit 11 vlan-id 2000
set interfaces ge-5/0/4 unit 11 input-vlan-map swap
set interfaces ge-5/0/4 unit 11 input-vlan-map vlan-id 4094
set interfaces ge-5/0/4 unit 11 output-vlan-map swap
set routing-options router-id 4.4.4.4
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 virtual-circuit-id 1003
set protocols l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 no-control-word
set protocols oam ethernet connectivity-fault-management performance-monitoring
  delegate-server-processing
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  level 4
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma continuity-check interval 1s
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 interface ge-5/0/4.11
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 direction up
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 remote-mep 1
set firewall three-color-policer abc logical-interface-policer
set firewall three-color-policer abc two-rate color-blind
set firewall three-color-policer abc two-rate committed-information-rate 10m
set firewall three-color-policer abc two-rate committed-burst-size 1500
set firewall three-color-policer abc two-rate peak-information-rate 20m
set firewall three-color-policer abc two-rate peak-burst-size 15k

```

On Router PE2:

```

[edit]
set interfaces ge-8/0/8 encapsulation flexible-ethernet-services
set interfaces ge-8/0/8 unit 11 encapsulation vlan-ccc
set interfaces ge-8/0/8 unit 11 layer2-policer input-three-color abc
set interfaces ge-8/0/8 unit 11 family ccc
set interfaces ge-8/0/9 enable
set interfaces ge-8/0/9 unit 0 family inet address 12.1.1.1/24
set interfaces ge-8/0/9 unit 0 family mpls
set interfaces ae0 unit 0 family inet
set interfaces lo0 unit 0 family inet address 3.3.3.3/32
set interfaces ge-8/0/8 flexible-vlan-tagging
set interfaces ge-8/0/8 unit 11 vlan-id 2000
set interfaces ge-8/0/8 unit 11 input-vlan-map swap
set interfaces ge-8/0/8 unit 11 input-vlan-map vlan-id 4094
set interfaces ge-8/0/8 unit 11 output-vlan-map swap
set routing-options router-id 3.3.3.3
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ldp interface all

```

```
set protocols ldp interface fxp0.0 disable
set protocols l2circuit neighbor 4.4.4.4 interface ge-8/0/8.11 virtual-circuit-id 1003
set protocols l2circuit neighbor 3.3.3.3 interface ge-8/0/8.11 no-control-word
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  level 4
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma continuity-check interval 1s
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 1 interface ge-8/0/8.11
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 1 direction up
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 1 remote-mep 2
set firewall three-color-policer abc logical-interface-policer
set firewall three-color-policer abc two-rate color-blind
set firewall three-color-policer abc two-rate committed-information-rate 10m
set firewall three-color-policer abc two-rate committed-burst-size 1500
set firewall three-color-policer abc two-rate peak-information-rate 20m
set firewall three-color-policer abc two-rate peak-burst-size 15k
```

---

### Configuring Router PE1

---

#### Step-by-Step Procedure

To configure Router PE1:

1. Configure the interfaces.

```
[edit]
user@PE1# edit interfaces
[edit interfaces]
user@PE1# set ge-5/0/4 encapsulation flexible-ethernet-services
user@PE1# set ge-5/0/4 unit 11 encapsulation vlan-ccc
user@PE1# set ge-5/0/4 unit 11 layer2-policer input-three-color abc
user@PE1# set ge-5/0/4 unit 11 family ccc
user@PE1# set ge-5/1/9 enable
user@PE1# set ge-5/1/9 unit 0 family inet address 12.1.1.1/24
user@PE1# set ge-5/1/9 unit 0 family mpls
user@PE1# set lo0 unit 0 family inet address 4.4.4.4/32
```

2. Configure the VLAN.

```
[edit interfaces]
user@PE1# set ge-5/0/4 flexible-vlan-tagging
user@PE1# set ge-5/0/4 unit 11 vlan-id 2000
user@PE1# set ge-5/0/4 unit 11 input-vlan-map swap
user@PE1# set ge-5/0/4 unit 11 input-vlan-map vlan-id 4094
user@PE1# set ge-5/0/4 unit 11 output-vlan-map swap
```

3. Configure the router identifier to identify the routing device.

```
[edit]
user@PE1# edit routing-options
[edit routing-options]
user@PE1# set router-id 4.4.4.4
```

4. Configure MPLS, OSPF, and LDP protocols.

```
[edit]
```

```

user@PE1# edit protocols
[edit protocols]
user@PE1# set mpls interface all
user@PE1# set mpls interface fxp0.0 disable
user@PE1# set ospf area 0.0.0.0 interface all
user@PE1# set ospf area 0.0.0.0 interface fxp0.0 disable
user@PE1# set ldp interface all
user@PE1# set ldp interface fxp0.0 disable

```

5. Configure the Layer 2 circuit.

```

[edit protocols]
user@PE1# set l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 virtual-circuit-id 1003
user@PE1# set l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 no-control-word

```

6. Configure the MEP.

```

[edit protocols]
user@PE1# set oam ethernet connectivity-fault-management
performance-monitoring delegate-server-processing
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md level 4
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma continuity-check interval 1s
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 interface ge-5/0/4.11
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 direction up
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 remote-mep 1

```

7. Configure the firewall.

```

[edit]
user@PE1# edit firewall
[edit firewall]
user@PE1# set three-color-policer abc logical-interface-policer
user@PE1# set three-color-policer abc two-rate color-blind
user@PE1# set three-color-policer abc two-rate committed-information-rate 10m
user@PE1# set three-color-policer abc two-rate committed-burst-size 1500
user@PE1# set three-color-policer abc two-rate peak-information-rate 20m
user@PE1# set three-color-policer abc two-rate peak-burst-size 15k

```

8. Commit the configuration.

```

[edit]
user@PE1# commit

```

**Results** From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show firewall** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```

user@PE1# show interfaces
interfaces {
  ge-5/0/4 {
    flexible-vlan-tagging;

```

```
encapsulation flexible-ethernet-services;
unit 11 {
    encapsulation vlan-ccc;
    vlan-id 2000;
    input-vlan-map {
        swap;
        vlan-id 4094;
    }
    output-vlan-map swap;
    layer2-policer {
        input-three-color abc;
    }
    family ccc;
}
}
ge-5/1/9 {
    enable;
    unit 0 {
        family inet {
            address 12.1.1.1/24;
        }
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 4.4.4.4/32;
        }
    }
}
}

user@PE1# show protocols
protocols {
    mpls {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    ospf {
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    ldp {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    l2circuit {
```



```

neighbor 3.3.3.3 {
  interface ge-5/0/4.11 {
    virtual-circuit-id 1003;
    no-control-word;
  }
}
oam {
  ethernet {
    connectivity-fault-management {
      performance-monitoring {
        delegate-server-processing;
      }
      maintenance-domain md {
        level 4;
        maintenance-association ma {
          continuity-check {
            interval 1s;
          }
          mep 2 {
            interface ge-5/0/4.11;
            direction up;
            remote-mep 1;
          }
        }
      }
    }
  }
}

user@PE1# show routing-options
routing-options {
  router-id 4.4.4.4;
}

user@PE1# show firewall
firewall {
  three-color-policer abc {
    logical-interface-policer;
    two-rate {
      color-blind;
      committed-information-rate 10m;
      committed-burst-size 1500;
      peak-information-rate 20m;
      peak-burst-size 15k;
    }
  }
}

```

### Configuring Router PE2

#### Step-by-Step Procedure

To configure Router PE2:

1. Configure the interfaces.

[edit]

```
user@PE2# edit interfaces
[edit interfaces]
user@PE2# set ge-8/0/8 encapsulation flexible-ethernet-services
user@PE2# set ge-8/0/8 unit 11 encapsulation vlan-ccc
user@PE2# set ge-8/0/8 unit 11 layer2-policer input-three-color abc
user@PE2# set ge-8/0/8 unit 11 family ccc
user@PE2# set ge-8/0/9 enable
user@PE2# set ge-8/0/9 unit 0 family inet address 12.1.1.1/24
user@PE2# set ge-8/0/9 unit 0 family mpls
user@PE2# set ae0 unit 0 family inet
user@PE2# set lo0 unit 0 family inet address 3.3.3.3/32
```

2. Configure the VLAN.

```
[edit interfaces]
user@PE2# set ge-8/0/8 flexible-vlan-tagging
user@PE2# set ge-8/0/8 unit 11 vlan-id 2000
user@PE2# set ge-8/0/8 unit 11 input-vlan-map swap
user@PE2# set ge-8/0/8 unit 11 input-vlan-map vlan-id 4094
user@PE2# set ge-8/0/8 unit 11 output-vlan-map swap
```

3. Configure the router identifier to identify the routing device.

```
[edit]
user@PE2# edit routing-options
[edit routing-options]
user@PE2# set router-id 3.3.3.3
```

4. Configure MPLS, OSPF, and LDP protocols.

```
[edit]
user@PE2# edit protocols
[edit protocols]
user@PE2# set mpls interface all
user@PE2# set mpls interface fxp0.0 disable
user@PE2# set ospf area 0.0.0.0 interface all
user@PE2# set ospf area 0.0.0.0 interface fxp0.0 disable
user@PE2# set ldp interface all
user@PE2# set ldp interface fxp0.0 disable
```

5. Configure the Layer 2 circuit.

```
[edit protocols]
user@PE2# set l2circuit neighbor 4.4.4.4 interface ge-8/0/8.11 virtual-circuit-id
1003
user@PE2# set l2circuit neighbor 3.3.3.3 interface ge-8/0/8.11 no-control-word
```

6. Configure the MEP.

```
[edit protocols]
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md level 4
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma continuity-check interval 1s
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 interface ge-8/0/8.11
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 direction up
```

```
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 remote-mep 2
```

7. Configure the firewall.

```
[edit]
user@PE2# edit firewall
[edit firewall]
user@PE2# set three-color-policer abc logical-interface-policer
user@PE2# set three-color-policer abc two-rate color-blind
user@PE2# set three-color-policer abc two-rate committed-information-rate 10m
user@PE2# set three-color-policer abc two-rate committed-burst-size 1500
user@PE2# set three-color-policer abc two-rate peak-information-rate 20m
user@PE2# set three-color-policer abc two-rate peak-burst-size 15k
```

8. Commit the configuration.

```
[edit]
user@PE2# commit
```

**Results** From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show firewall** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
interfaces {
  ge-8/0/8 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 11 {
      encapsulation vlan-ccc;
      vlan-id 2000;
      input-vlan-map {
        swap;
        vlan-id 4094;
      }
      output-vlan-map swap;
      layer2-policer {
        input-three-color abc;
      }
      family ccc;
    }
  }
  ge-8/0/9 {
    unit 0 {
      family inet {
        address 12.1.1.2/24;
      }
      family mpls;
    }
  }
  ae0 {
    unit 0 {
      family inet;
    }
  }
}
```

```
}
lo0 {
  unit 0 {
    family inet {
      address 3.3.3.3/32;
    }
  }
}

user@PE2# show protocols
protocols {
  mpls {
    interface all;
    interface fxp0.0 {
      disable;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface all;
      interface fxp0.0 {
        disable;
      }
    }
  }
  ldp {
    interface all;
    interface fxp0.0 {
      disable;
    }
  }
  l2circuit {
    neighbor 4.4.4.4 {
      interface ge-8/0/8.11 {
        virtual-circuit-id 1003;
        no-control-word;
      }
    }
  }
  oam {
    ethernet {
      connectivity-fault-management {
        maintenance-domain md {
          level 4;
          maintenance-association ma {
            continuity-check {
              interval 1s;
            }
            mep 1 {
              interface ge-8/0/8.11;
              direction up;
              remote-mep 2;
            }
          }
        }
      }
    }
  }
}
```

```

    }
  }
}

user@PE2# show routing-options
routing-options {
  router-id 3.3.3.3;
}

user@PE2# show firewall
firewall {
  three-color-policer abc {
    logical-interface-policer;
    two-rate {
      color-blind;
      committed-information-rate 10m;
      committed-burst-size 1500;
      peak-information-rate 20m;
      peak-burst-size 15k;
    }
  }
}

```

## Verification

To start monitoring the Ethernet frame loss, issue the **monitor ethernet loss-measurement maintenance-domain md maintenance-association ma mep 1** command. Frame loss is calculated by collecting the counter values applicable for ingress and egress service frames where the counters maintain a count of transmitted and received data frames between a pair of MEPs. The loss measurement statistics are retrieved as the output of the **monitor ethernet loss-measurement** command. You can also issue the **show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11** command to display ETH-LM statistics.

### Viewing ETH-LM

**Purpose** View the ETH-LM statistics.

**Action** From operational mode, enter the **show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11** command.

```

user@PE1> show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11
Interface name: ge-5/0/4.11 , Interface status: Active, Link status: Up
Maintenance domain name: md, Format: string, Level: 4
Maintenance association name: ma, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no
MEP identifier: 2, Direction: up, MAC address: 00:24:dc:9b:96:76
MEP status: running
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                       : no
  Cross-connect CCM received                   : no
  RDI sent by some MEP                        : no

```

```

    Some remote MEP's MAC in error state      : no
Statistics:
  CCMs sent                                  : 36
  CCMs received out of sequence              : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received               : 0
  Valid out-of-order LBRs received          : 0
  LBRs received with corrupted data         : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                             : 0
  LTRs sent                                  : 0
  LTRs received                             : 0
  Sequence number of next LTM request       : 0
  1DMs sent                                  : 0
  Valid 1DMs received                       : 0
  Invalid 1DMs received                     : 0
  Out of sync 1DMs received                 : 0
  DMMs sent                                  : 0
  Valid DMMs received                       : 0
  Invalid DMMs received                     : 0
  DMRs sent                                  : 0
  Valid DMRs received                       : 0
  Invalid DMRs received                     : 0
  LMMs sent                                  : 10
  Valid LMMs received                       : 0
  Invalid LMMs received                     : 0
  LMRs sent                                  : 0
  Valid LMRs received                       : 10
  Invalid LMRs received                     : 0
  SLMs sent                                  : 0
  Valid SLMs received                       : 0
  Invalid SLMs received                     : 0
  SLRs sent                                  : 0
  Valid SLRs received                       : 0
  Invalid SLRs received                     : 0
Remote MEP count: 1
  Identifier  MAC address  State  Interface
    1        00:05:85:76:e5:30  ok    ge-5/0/4.11

```

**Meaning** The Ethernet interface details and statistics are displayed. This output indicates that the **ge-5/0/4.11** interface is active and its link status is **up**. Its maintenance domain name is **md** and its level is **4**. The MEP identifier of the **ge-5/0/4.11** interface is indicated as **2** and its direction is **up**. Under the statistics section, the output indicates that **10** LMMs were sent and **10** valid LMRs were received by the interface.

**Related Documentation**

- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs on page 722](#)

## Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs

This example illustrates how to configure Ethernet frame loss measurement (ETH-LM) for dual-tagged Loss Measurement Message (LMM)/Loss Measurement Reply (LMR)

protocol data units (PDUs). By configuring ETH-LM, you can measure the Ethernet frame loss that occur in your network.

- [Requirements on page 723](#)
- [Overview and Topology on page 723](#)
- [Configuration on page 724](#)
- [Verification on page 732](#)

## Requirements

This example uses the following hardware and software components:

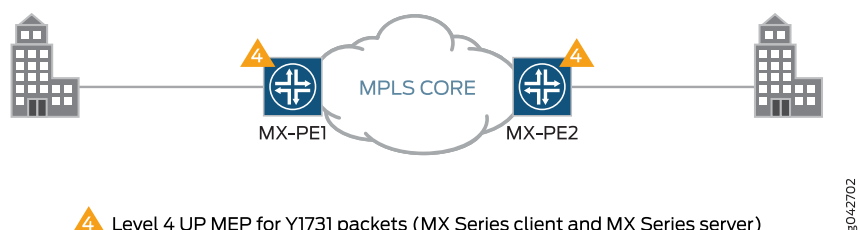
- Two MX Series 3D Universal Edge Routers with Rev-B Dense Port Concentrators (DPCs)
- Junos OS Release 14.2 or later

## Overview and Topology

Junos OS supports Ethernet frame loss measurement (ETH-LM) between maintenance association end points (MEPs) configured on Ethernet physical or logical interfaces on Rev-B Dense Port Concentrators (DPCs) in MX Series routers. Additionally, the Y.1731 functionality supports ETH-LM only for an end-to-end connection that uses Virtual Private Wire Service (VPWS). This example illustrates how to configure ETH-LM for dual tagged LMM/LMR PDUs with input and output VLAN map configured as **swap-swap**.

[Figure 49 on page 723](#) shows the topology used in this example. VPWS service is configured between two MX Series routers, MX-PE1 and MX-PE2.

**Figure 49: VPWS Service Configured Between Two MX Series Routers**



MX-PE1 router has two Ethernet interfaces, **ge-5/0/4** and **ge-5/1/9**. Virtual LAN (VLAN) is configured on **ge-5/0/4** and MPLS is configured on the **ge-5/1/9** interface. The **ge-5/0/4.11** interface is used to configure the Layer 2 virtual circuit with MX-PE2 router. The UP MEP, **mep 2**, is attached to the **ge-5/0/4.11** interface. The three-color policer firewall filter is also configured for the MX-PE1 router.

Similarly, MX-PE2 router has two Ethernet interfaces, **ge-8/0/8** and **ge-8/0/9**. Virtual LAN (VLAN) is configured on **ge-8/0/8** and MPLS is configured on the **ge-8/0/9** interface. The **ge-8/0/8.11** interface is used to configure the Layer 2 virtual circuit with MX-PE1 router. The UP MEP, **mep 1**, is attached to the **ge-8/0/8.11** interface. The three-color policer firewall filter is also configured for the MX-PE2 router.

## Configuration

**CLI Quick Configuration** To quickly configure ETH-LM for dual tagged LMM/LMR PDUs, copy the following commands, remove any line breaks, and then paste the commands into the CLI of each device.

On Router PE1:

```
[edit]
set interfaces ge-5/0/4 encapsulation flexible-ethernet-services
set interfaces ge-5/0/4 unit 11 encapsulation vlan-ccc
set interfaces ge-5/0/4 unit 11 layer2-policer input-three-color abc
set interfaces ge-5/0/4 unit 11 family ccc
set interfaces ge-5/1/9 enable
set interfaces ge-5/1/9 unit 0 family inet address 12.1.1.1/24
set interfaces ge-5/1/9 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 4.4.4.4/32
set interfaces ge-5/0/4 flexible-vlan-tagging
set interfaces ge-5/0/4 unit 11 vlan-tags outer 2000 inner 1000
set interfaces ge-5/0/4 unit 11 input-vlan-map swap-swap
set interfaces ge-5/0/4 unit 11 input-vlan-map vlan-id 4094
set interfaces ge-5/0/4 unit 11 input-vlan-map inner-vlan-id 4093
set interfaces ge-5/0/4 unit 11 output-vlan-map swap-swap
set routing-options router-id 4.4.4.4
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 virtual-circuit-id 1003
set protocols l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 no-control-word
set protocols oam ethernet connectivity-fault-management performance-monitoring
  delegate-server-processing
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  level 4
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma continuity-check interval 1s
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 interface ge-5/0/4.11
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 direction up
set protocols oam ethernet connectivity-fault-management maintenance-domain md
  maintenance-association ma mep 2 remote-mep 1
set firewall three-color-policer abc logical-interface-policer
set firewall three-color-policer abc two-rate color-blind
set firewall three-color-policer abc two-rate committed-information-rate 10m
set firewall three-color-policer abc two-rate committed-burst-size 1500
set firewall three-color-policer abc two-rate peak-information-rate 20m
set firewall three-color-policer abc two-rate peak-burst-size 15k
```

On Router PE2:

```
[edit]
set interfaces ge-8/0/8 encapsulation flexible-ethernet-services
set interfaces ge-8/0/8 unit 11 encapsulation vlan-ccc
```



```

set interfaces ge-8/0/8 unit 11 layer2-policer input-three-color abc
set interfaces ge-8/0/8 unit 11 family ccc
set interfaces ge-8/0/9 enable
set interfaces ge-8/0/9 unit 0 family inet address 12.1.1.1/24
set interfaces ge-8/0/9 unit 0 family mpls
set interfaces ae0 unit 0 family inet
set interfaces lo0 unit 0 family inet address 3.3.3.3/32
set interfaces ge-8/0/8 flexible-vlan-tagging
set interfaces ge-8/0/8 unit 11 vlan-tags outer 2000 inner 1000
set interfaces ge-8/0/8 unit 11 input-vlan-map swap-swap
set interfaces ge-8/0/8 unit 11 input-vlan-map vlan-id 4094
set interfaces ge-8/0/8 unit 11 input-vlan-map inner-vlan-id 4093
set interfaces ge-8/0/8 unit 11 output-vlan-map swap-swap
set routing-options router-id 3.3.3.3
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set protocols l2circuit neighbor 4.4.4.4 interface ge-8/0/8.11 virtual-circuit-id 1003
set protocols l2circuit neighbor 3.3.3.3 interface ge-8/0/8.11 no-control-word
set protocols oam ethernet connectivity-fault-management maintenance-domain md
    level 4
set protocols oam ethernet connectivity-fault-management maintenance-domain md
    maintenance-association ma continuity-check interval 1s
set protocols oam ethernet connectivity-fault-management maintenance-domain md
    maintenance-association ma mep 1 interface ge-8/0/8.11
set protocols oam ethernet connectivity-fault-management maintenance-domain md
    maintenance-association ma mep 1 direction up
set protocols oam ethernet connectivity-fault-management maintenance-domain md
    maintenance-association ma mep 1 remote-mep 2
set firewall three-color-policer abc logical-interface-policer
set firewall three-color-policer abc two-rate color-blind
set firewall three-color-policer abc two-rate committed-information-rate 10m
set firewall three-color-policer abc two-rate committed-burst-size 1500
set firewall three-color-policer abc two-rate peak-information-rate 20m
set firewall three-color-policer abc two-rate peak-burst-size 15k

```

### Configuring Router PE1

#### Step-by-Step Procedure

To configure Router PE1:

1. Configure the interfaces.

```

[edit]
user@PE1# edit interfaces
[edit interfaces]
user@PE1# set ge-5/0/4 encapsulation flexible-ethernet-services
user@PE1# set ge-5/0/4 unit 11 encapsulation vlan-ccc
user@PE1# set ge-5/0/4 unit 11 layer2-policer input-three-color abc
user@PE1# set ge-5/0/4 unit 11 family ccc
user@PE1# set ge-5/1/9 enable
user@PE1# set ge-5/1/9 unit 0 family inet address 12.1.1.1/24
user@PE1# set ge-5/1/9 unit 0 family mpls
user@PE1# set lo0 unit 0 family inet address 4.4.4.4/32

```

2. Configure the VLAN.

```
[edit interfaces]
user@PE1# set ge-5/0/4 flexible-vlan-tagging
user@PE1# set ge-5/0/4 unit 11 vlan-tags outer 2000 inner 1000
user@PE1# set ge-5/0/4 unit 11 input-vlan-map swap-swap
user@PE1# set ge-5/0/4 unit 11 input-vlan-map vlan-id 4094
user@PE1# set ge-5/0/4 unit 11 input-vlan-map inner-vlan-id 4093
user@PE1# set ge-5/0/4 unit 11 output-vlan-map swap-swap
```

3. Configure the router identifier to identify the routing device.

```
[edit]
user@PE1# edit routing-options
[edit routing-options]
user@PE1# set router-id 4.4.4.4
```

4. Configure MPLS, OSPF, and LDP protocols.

```
[edit]
user@PE1# edit protocols
[edit protocols]
user@PE1# set mpls interface all
user@PE1# set mpls interface fxp0.0 disable
user@PE1# set ospf area 0.0.0.0 interface all
user@PE1# set ospf area 0.0.0.0 interface fxp0.0 disable
user@PE1# set ldp interface all
user@PE1# set ldp interface fxp0.0 disable
```

5. Configure the Layer 2 circuit.

```
[edit protocols]
user@PE1# set l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 virtual-circuit-id 1003
user@PE1# set l2circuit neighbor 3.3.3.3 interface ge-5/0/4.11 no-control-word
```

6. Configure the MEP.

```
[edit protocols]
user@PE1# set oam ethernet connectivity-fault-management
performance-monitoring delegate-server-processing
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md level 4
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma continuity-check interval 1s
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 interface ge-5/0/4.11
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 direction up
user@PE1# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 2 remote-mep 1
```

7. Configure the firewall.

```
[edit]
user@PE1# edit firewall
[edit firewall]
user@PE1# set three-color-policer abc logical-interface-policer
user@PE1# set three-color-policer abc two-rate color-blind
user@PE1# set three-color-policer abc two-rate committed-information-rate 10m
```

```

user@PE1# set three-color-policer abc two-rate committed-burst-size 1500
user@PE1# set three-color-policer abc two-rate peak-information-rate 20m
user@PE1# set three-color-policer abc two-rate peak-burst-size 15k

```

8. Commit the configuration.

```

[edit]
user@PE1# commit

```

**Results** From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show firewall** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```

user@PE1# show interfaces
interfaces {
  ge-5/0/4 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 11 {
      encapsulation vlan-ccc;
      vlan-tags outer 2000 inner 1000;
      input-vlan-map {
        swap-swap;
        vlan-id 4094;
        inner-vlan-id 4093;
      }
      output-vlan-map swap-swap;
      layer2-policer {
        input-three-color abc;
      }
      family ccc;
    }
  }
  ge-5/1/9 {
    enable;
    unit 0 {
      family inet {
        address 12.1.1.1/24;
      }
      family mpls;
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 4.4.4.4/32;
      }
    }
  }
}

user@PE1# show protocols
protocols {
  mpls {
    interface all;
  }
}

```

```
        interface fxp0.0 {
            disable;
        }
    }
    ospf {
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    ldp {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    l2circuit {
        neighbor 3.3.3.3 {
            interface ge-5/0/4.11 {
                virtual-circuit-id 1003;
                no-control-word;
            }
        }
    }
    oam {
        ethernet {
            connectivity-fault-management {
                performance-monitoring {
                    delegate-server-processing;
                }
            }
            maintenance-domain md {
                level 4;
                maintenance-association ma {
                    continuity-check {
                        interval 1s;
                    }
                    mep 2 {
                        interface ge-5/0/4.11;
                        direction up;
                        remote-mep 1;
                    }
                }
            }
        }
    }
}

user@PE1# show routing-options
routing-options {
    router-id 4.4.4.4;
}

user@PE1# show firewall
firewall {
```

```

three-color-policer abc {
  logical-interface-policer;
  two-rate {
    color-blind;
    committed-information-rate 10m;
    committed-burst-size 1500;
    peak-information-rate 20m;
    peak-burst-size 15k;
  }
}
}

```

### Configuring Router PE2

#### Step-by-Step Procedure

To configure Router PE2:

1. Configure the interfaces.

```

[edit]
user@PE2# edit interfaces
[edit interfaces]
user@PE2# set ge-8/0/8 encapsulation flexible-ethernet-services
user@PE2# set ge-8/0/8 unit 11 encapsulation vlan-ccc
user@PE2# set ge-8/0/8 unit 11 layer2-policer input-three-color abc
user@PE2# set ge-8/0/8 unit 11 family ccc
user@PE2# set ge-8/0/9 enable
user@PE2# set ge-8/0/9 unit 0 family inet address 12.1.1.1/24
user@PE2# set ge-8/0/9 unit 0 family mpls
user@PE2# set ae0 unit 0 family inet
user@PE2# set lo0 unit 0 family inet address 3.3.3.3/32

```

2. Configure the VLAN.

```

[edit interfaces]
user@PE2# set ge-8/0/8 flexible-vlan-tagging
user@PE2# set ge-8/0/8 unit 11 vlan-tags outer 2000 inner 1000
user@PE2# set ge-8/0/8 unit 11 input-vlan-map swap-swap
user@PE2# set ge-8/0/8 unit 11 input-vlan-map vlan-id 4094
user@PE2# set ge-8/0/8 unit 11 input-vlan-map inner-vlan-id 4093
user@PE2# set ge-8/0/8 unit 11 output-vlan-map swap-swap

```

3. Configure the router identifier to identify the routing device.

```

[edit]
user@PE2# edit routing-options
[edit routing-options]
user@PE2# set router-id 3.3.3.3

```

4. Configure MPLS, OSPF, and LDP protocols.

```

[edit]
user@PE2# edit protocols
[edit protocols]
user@PE2# set mpls interface all
user@PE2# set mpls interface fxp0.0 disable
user@PE2# set ospf area 0.0.0.0 interface all
user@PE2# set ospf area 0.0.0.0 interface fxp0.0 disable

```

```
user@PE2# set ldp interface all
user@PE2# set ldp interface fxp0.0 disable
```

5. Configure the Layer 2 circuit.

```
[edit protocols]
user@PE2# set l2circuit neighbor 4.4.4.4 interface ge-8/0/8.11 virtual-circuit-id
1003
user@PE2# set l2circuit neighbor 3.3.3.3 interface ge-8/0/8.11 no-control-word
```

6. Configure the MEP.

```
[edit protocols]
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md level 4
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma continuity-check interval 1s
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 interface ge-8/0/8.11
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 direction up
user@PE2# set oam ethernet connectivity-fault-management maintenance-domain
md maintenance-association ma mep 1 remote-mep 2
```

7. Configure the firewall.

```
[edit]
user@PE2# edit firewall
[edit firewall]
user@PE2# set three-color-policer abc logical-interface-policer
user@PE2# set three-color-policer abc two-rate color-blind
user@PE2# set three-color-policer abc two-rate committed-information-rate 10m
user@PE2# set three-color-policer abc two-rate committed-burst-size 1500
user@PE2# set three-color-policer abc two-rate peak-information-rate 20m
user@PE2# set three-color-policer abc two-rate peak-burst-size 15k
```

8. Commit the configuration.

```
[edit]
user@PE2# commit
```

**Results** From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show firewall** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
interfaces {
  ge-8/0/8 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 11 {
      encapsulation vlan-ccc;
      vlan-tags outer 2000 inner 1000;
      input-vlan-map {
        swap-swap;
        vlan-id 4094;
      }
    }
  }
}
```

```

        inner-vlan-id 4093;
    }
    output-vlan-map swap-swap;
    layer2-policer {
        input-three-color abc;
    }
    family ccc;
}
}
ge-8/0/9 {
    unit 0 {
        family inet {
            address 12.1.1.2/24;
        }
        family mpls;
    }
}
ae0 {
    unit 0 {
        family inet;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 3.3.3.3/32;
        }
    }
}
}
}

```

```

user@PE2# show protocols

```

```

protocols {
    mpls {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    ospf {
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    ldp {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
    l2circuit {
        neighbor 4.4.4.4 {
            interface ge-8/0/8.11 {

```

```
        virtual-circuit-id 1003;
        no-control-word;
    }
}
oam {
    ethernet {
        connectivity-fault-management {
            maintenance-domain md {
                level 4;
                maintenance-association ma {
                    continuity-check {
                        interval 1s;
                    }
                    mep 1 {
                        interface ge-8/0/8.11;
                        direction up;
                        remote-mep 2;
                    }
                }
            }
        }
    }
}

user@PE2# show routing-options
routing-options {
    router-id 3.3.3.3;
}

user@PE2# show firewall
firewall {
    three-color-policer abc {
        logical-interface-policer;
        two-rate {
            color-blind;
            committed-information-rate 10m;
            committed-burst-size 1500;
            peak-information-rate 20m;
            peak-burst-size 15k;
        }
    }
}
```

## Verification

To start the Ethernet frame loss measurement session, issue the **monitor ethernet loss-measurement maintenance-domain md maintenance-association ma mep 1** command. Frame loss is calculated by collecting the counter values applicable for ingress and egress service frames where the counters maintain a count of transmitted and received data frames between a pair of MEPs. The loss measurement statistics are retrieved as the output of the **monitor ethernet loss-measurement** command. You can also issue the **show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11** command to display ETH-LM statistics.



## Viewing ETH-LM

**Purpose** View the ETH-LM statistics.

**Action** From operational mode, enter the **show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11** command.

```
user@PE1> show oam ethernet connectivity-fault-management interfaces detail ge-5/0/4.11
Interface name: ge-5/0/4.11 , Interface status: Active, Link status: Up
Maintenance domain name: md, Format: string, Level: 4
Maintenance association name: ma, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no
MEP identifier: 2, Direction: up, MAC address: 00:24:dc:9b:96:76
MEP status: running
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : no
  Some remote MEP's MAC in error state        : no
Statistics:
  CCMs sent                                  : 59
  CCMs received out of sequence               : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received                : 0
  Valid out-of-order LBRs received            : 0
  LBRs received with corrupted data           : 0
  LBRs sent                                   : 0
  LTMs sent                                  : 0
  LTMs received                              : 0
  LTRs sent                                  : 0
  LTRs received                              : 0
  Sequence number of next LTM request         : 0
  1DMs sent                                  : 0
  Valid 1DMs received                        : 0
  Invalid 1DMs received                      : 0
  Out of sync 1DMs received                  : 0
  DMMs sent                                  : 0
  Valid DMMs received                        : 0
  Invalid DMMs received                      : 0
  DMRs sent                                  : 0
  Valid DMRs received                        : 0
  Invalid DMRs received                      : 0
  LMMs sent                                  : 10
  Valid LMMs received                        : 0
  Invalid LMMs received                      : 0
  LMRs sent                                  : 0
  Valid LMRs received                        : 10
  Invalid LMRs received                      : 0
  SLMs sent                                  : 0
  Valid SLMs received                        : 0
  Invalid SLMs received                      : 0
  SLRs sent                                  : 0
  Valid SLRs received                        : 0
  Invalid SLRs received                      : 0
Remote MEP count: 1
  Identifier  MAC address  State  Interface
```

```
1      00:05:85:76:e5:30      ok      ge-5/0/4.11
```

**Meaning** The Ethernet interface details and statistics are displayed. This output indicates that the **ge-5/0/4.11** interface is active and its link status is **up**. Its maintenance domain name is **md** and its level is **4**. The MEP identifier of the **ge-5/0/4.11** interface is indicated as **2** and its direction is **up**. Under the statistics section, the output indicates that **10** LMMs were sent and **10** valid LMRs were received by the interface.

**Related Documentation**

- [Ethernet Frame Loss Measurement Overview on page 628](#)
- [Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs on page 711](#)

## Triggering an Ethernet Frame Delay Measurements Session

Before Ethernet frame delay measurement statistics can be displayed, they must be collected. To trigger Ethernet frame delay measurement, use the **monitor ethernet delay-measurement (one-way | two-way) (remote-mac-address | mep identifier) maintenance-domain *name* maintenance-association *ma-id* [count *count*] [wait *time*]** operational command.

The fields for this command are described in [Table 62 on page 734](#).

**Table 62: Monitor Ethernet Delay Command Parameters**

Parameter	Parameter Range	Description
<b>one-way</b> or <b>two-way</b>	NA	Perform a one-way or two-way (round-trip) delay measurement.
<b><i>remote-mac-address</i></b>	Unicast MAC address	Send delay measurement frames to the destination unicast MAC address (use the format <code>xx:xx:xx:xx:xx:xx</code> ). Multicast MAC addresses are not supported.
<b><i>mep identifier</i></b>	1–8191	The MEP identifier to use for the measurement. The discovered MAC address for this MEP identifier is used.
<b><i>maintenance-domain name</i></b>	Existing MD name	Specifies an existing maintenance domain (MD) to use for the measurement.
<b><i>maintenance-association ma-id</i></b>	Existing MA identifier	Specifies an existing maintenance association (MA) identifier to use for the measurement.
<b><i>count count</i></b>	1–65535 (default: 10)	(Optional) Specifies the number of Ethernet frame delay frames to send. The default is 10.
<b><i>wait time</i></b>	1–255 seconds (default: 1)	(Optional) Specifies the number of seconds to wait between frames. The default is 1 second.

If you attempt to monitor delays to a nonexistent MAC address, you must exit the application manually using **^C**:

```

user@host> monitor ethernet delay-measurement two-way 00:11:22:33:44:55
Two-way ETH-DM request to 00:11:22:33:44:55, Interface ge-5/2/9.0
^C
--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 0
Average delay: 0 usec, Average delay variation: 0 usec
Best case delay: 0 usec, Worst case delay: 0 usec

```

#### Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Ethernet Frame Delay Measurements*
- *Configuring MEP Interfaces to Support ETH-DM*
- [Viewing ETH-DM Statistics on page 735](#)
- [Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 700](#)
- [Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 705](#)
- [Configuring ETH-DM with Untagged Interfaces on page 709](#)

## Viewing Ethernet Frame Delay Measurements Statistics

Once Ethernet frame delay measurement statistics have been collected, they can be displayed.

To retrieve the last 100 Ethernet frame delay measurement statistics per remote MEP or per CFM session, two types of **show** commands are provided:

- For all OAM frame counters and Ethernet frame delay measurement statistics
- For Ethernet frame delay measurement statistics only

To retrieve all Ethernet frame delay measurement statistics for a given session, use the **show oam ethernet connectivity-fault-management mep-statistics maintenance-domain *name* maintenance-association *name* [local-mep *identifier*] [remote-mep *identifier*] [count *count*]** command.

To retrieve only Ethernet frame delay measurement statistics for a given session, use the **show oam ethernet connectivity-fault-management delay-statistics maintenance-domain *name* maintenance-association *name* [local-mep *identifier*] [remote-mep *identifier*] [count *count*]** command.



**NOTE:** The only difference in the two commands is the use of the **mep-statistics** and **delay-statistics** keyword.

The fields for these commands are described in [Table 63 on page 736](#).

Table 63: Show Ethernet Delay Command Parameters

Parameter	Parameter Range	Description
<b>maintenance-domain</b> <i>name</i>	Existing MD name	Specifies an existing maintenance domain (MD) to use.
<b>maintenance-association</b> <i>ma-id</i>	Existing MA identifier	Specifies an existing maintenance association (MA) identifier to use.
<b>local-mep</b> <i>identifier</i>	1–8191	When a MEP has been specified, display statistics only for the local MEP.
<b>remote-mep</b> <i>identifier</i>	1–8191	When a MEP has been specified, display statistics only for the discovered MEP.
<b>count</b> <i>count</i>	1–100 (default:100)	The number of entries to display in the results table. By default, all 100 entries are displayed if they exist.



**NOTE:** For each MEP, you will see frame counters for sent and received Ethernet frame delay measurement frames whenever MEP statistics are displayed.

#### Related Documentation

- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Frame Delay Measurements](#)
- [Configuring MEP Interfaces to Support ETH-DM](#)
- [Triggering an ETH-DM Session on page 734](#)
- [Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 700](#)
- [Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 705](#)
- [Configuring ETH-DM with Untagged Interfaces on page 709](#)

# Configuring Ethernet Ring Protection

- [Ethernet Ring Protection on page 737](#)
- [Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739](#)
- [Example: Configuring Ethernet Ring Protection for MX Series Routers on page 740](#)
- [Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 746](#)
- [Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 763](#)
- [Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition on page 765](#)

## Ethernet Ring Protection

---

Link failure is often an unavoidable part of networking. However, there are methods of improving the reliability of a router or bridge network even when link failures occur. For example, SONET/SDH seal-healing rings are frequently used to add a level of robustness to router networks. This ring protection switching is now extended to Ethernet links. You can configure Ethernet ring protection for a series of two or more systems so that if one link fails, traffic is rerouted around the failure on the ring.

The basic idea of Ethernet ring protection is to use one specific link to protect the whole ring. This special link is the ring protection link (RPL). When all links are up and running, the RPL blocks traffic and remains idle. The RPL itself is controlled by the designated RPL owner node. There is only one RPL owner node on the ring and the RPL owner node is responsible for blocking the RPL interface under normal operating conditions. However, if a link failure occurs on the ring, the RPL owner node is responsible for unblocking the RPL interface and protection—switching the traffic on the alternate path around the ring. An Ethernet ring automatic protection switching (R-APS) messaging protocol coordinates the protection activities of all nodes on the ring. The APS blocks traffic over the failed link and unblocks traffic over the RPL.

When the failed link is repaired, the traffic reverts to its normal pattern. That is, the RPL owner blocks the RPL link and unblocks traffic over the cleared link.

Two or more nodes form a ring. Links between the nodes form a chain, with the last node also connecting the first. Every ring node therefore has two ports related to the ring, one in each direction. In this chapter, these directions are referred to as east and west.

Every node on the ring is one of two types:

- RPL owner node—This node owns the RPL and blocks or unblocks the RPL as conditions require. This node initiates the R-APS message.
- Normal node—All other nodes on the ring (that is, those that are not the RPL owner node) operate as normal nodes and have no special role on the ring.

In addition to roles, each node on the Ethernet ring can be in one of several states:

- Init—The node is not yet participating in the ring.
- Idle—The node is performing normally (there is no link failure on the ring). In this state, traffic is unblocked on both ring ports, except for the RPL owner node, which blocks the RPL port (the other RPL owner port is unblocked).
- Protection—When a failure occurs on the ring, a normal node will have traffic blocked on the ring port that connects to the failed link. The RPL owner, if it is not at one end of the failed link, will then unblock the RPL port so both ports are active.



**NOTE:** The R-APS protocol does not detect the number of RPL owner nodes configured on the ring. You must configure only one RPL and RPL owner per ring or protection switching will not work properly.

Ethernet ring protection only works when one link on the ring fails. Multiple link failures will break the ring and cause protection switching to fail.

Several restrictions apply to Ethernet ring protection:

- The Ethernet ring protection configured as a single instance only works at the physical level (adjacent nodes must be directly connected). The ring protection operates at the interface (port) level and not at the VLAN level.
- Manual (command-based) switching to protection mode is not supported.
- Nonrevertive switching is not supported. When the link failure is cleared, traffic always returns to normal operation.
- The interconnection of multiple rings for protection purposes is not supported.

You can configure Ethernet ring protection to optimize traffic load-balancing by using multiple ring instances. For more information about multiple ring instances, see [“Ethernet Ring Protection Using Ring Instances for Load Balancing” on page 739](#)

**Related  
Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Example: Configuring Ethernet Ring Protection for MX Series Routers on page 740](#)
- [Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 763](#)
- [Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition on page 765](#)
- [Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739](#)

- [Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 746](#)

## Ethernet Ring Protection Using Ring Instances for Load Balancing

Juniper Network MX Series 3D Universal Edge Routers support Ethernet ring protection (ERP) to help achieve high reliability and network stability. ERP is used in router or bridge networks to protect against link failure. A single-ring topology is configured that uses one specific link called a ring protection link (RPL) to protect the whole ring. When all links are up and running, the RPL blocks traffic and remains idle. However, if a link fails, the RPL routes traffic to bypass the failure on the ring.



**NOTE:** To learn how ERP works in a single-ring topology, see [“Ethernet Ring Protection” on page 737](#).

MX Series routers now support ERP ring instances. Whereas traffic in a single-ring topology follows the same path, traffic within ring instances allows some traffic to pass through one path while other traffic can follow a different path. Dividing traffic in this way supports traffic load balancing in the physical ring.

Ring instances are like traffic channels that contain different sets of virtual LANS (VLANs). A ring instance is responsible for the protection of a subset of VLANs that transport traffic over the physical ring. When ring instances are configured for the ring, each ring instance should have its own RPL owner, an east and a west interface, and a ring protection link end.

Each ring instance has a control channel and a specific data channel. A data channel is a group of bridge domain VLAN IDs. All VLAN IDs within the same ring interface share the same data-forwarding properties controlled by the ERP. If no data channel is defined in the ring configuration, ERP will only operate on the physical link instead of as a ring instance using logical links.

When operating ERP in a topology with other protocols, the following considerations should be observed:

- If a physical interface is part of an Ethernet ring, it cannot be configured for Spanning Tree Protocol (STP) or Multiple Spanning Tree Protocol (MSTP).
- ERP and Per-VLAN Spanning Tree (PVST) can be configured on the same topology as long as PVST doesn't share the same VLAN with any Ethernet ring instance configured on the physical port.
- If ERP is configured only as a physical ring instance (a ring without a data channel) in a topology also configured for PVST, ERP checks the PVST configuration on two ring interfaces and automatically creates a data channel excluding VLANs used by PVST.

### Related Documentation

- [Ethernet Ring Protection on page 737](#)
- [Example: Configuring Ethernet Ring Protection for MX Series Routers on page 740](#)

## Example: Configuring Ethernet Ring Protection for MX Series Routers

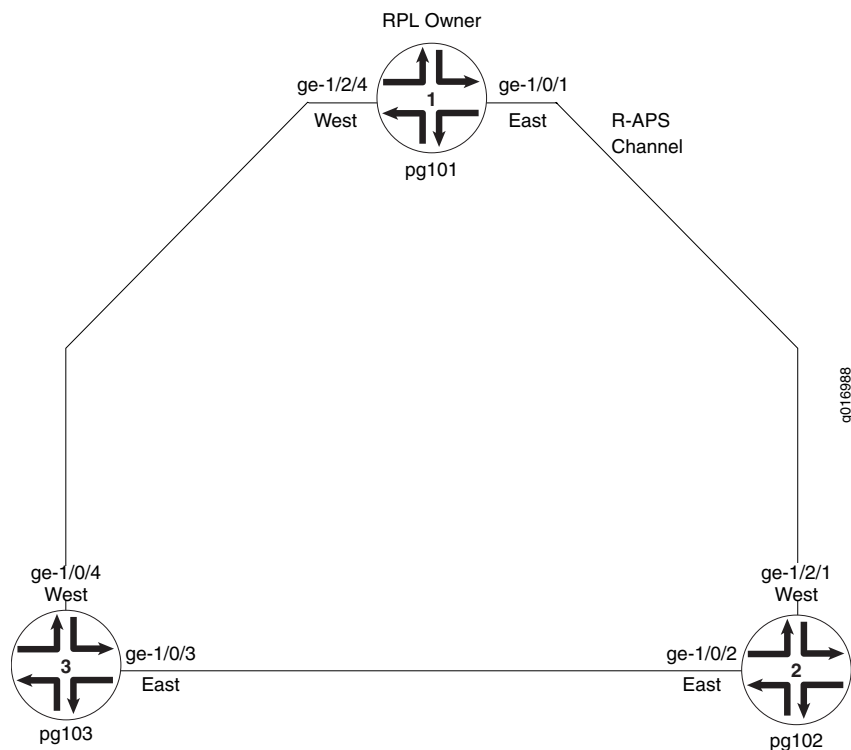
This example configures Ethernet ring protection for three MX Series router nodes:

- [Example Topology on page 740](#)
- [Router 1 \(RPL Owner\) Configuration on page 741](#)
- [Router 2 Configuration on page 743](#)
- [Router 3 Configuration on page 744](#)

### Example Topology

The links connecting the three MX Series routers are shown in [Figure 50 on page 740](#).

**Figure 50: Ethernet Ring Protection Example Nodes**



This example uses the following topology details for Ethernet ring protection:

- Router 1 is the RPL owner. The node identification for Router 1 is MAC address **00:01:01:00:00:01**.
- The RPL link is **ge-1/0/1.1** (this is also the R-APS messaging control channel).
- Traffic flows among the nodes in the configured bridge domains. (That is, only the control channels are configured.)
- Router 1's east control channel interface is **ge-1/0/1.1** (the RPL) and the west control channel interface is **ge-1/2/4.1**. The protection group is **pg101**.



- Router 2's east control channel interface is **ge-1/0/2.1** (the RPL) and the west control channel interface is **ge-1/2/1.1**. The protection group is **pg102**.
- Router 3's east control channel interface is **ge-1/0/3.1** (the RPL) and the west control channel interface is **ge-1/0/4.1**. The protection group is **pg103**.



**NOTE:** Although not strictly required for physical ring protection, this example configures Ethernet OAM with MEPs.

## Router 1 (RPL Owner) Configuration

To configure Router 1 (the RPL owner):

1. Configure the interfaces:

```
[edit]
interfaces {
  ge-1/0/1 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
  ge-1/2/4 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
  irb {
    unit 0 {
      family inet {
        address address 192.1.1.11/24;
      }
    }
  }
}
```

2. Configure the bridge domain:

```
[edit]
bridge-domains {
  bd1 {
    domain-type bridge;
    vlan-id 100;
    interface ge-1/2/4.1;
    interface ge-1/0/1.1;
    routing-interface irb.0;
  }
}
```

## 3. Configure the Ethernet ring protection group:

```
[edit]
protocols {
  protection-group {
    ethernet-ring pg101 {
      node-id 00:01:01:00:00:01;
      ring-protection-link-owner;
      east-interface {
        control-channel ge-1/0/1.1;
      }
      ring-protection-link-end;
      west-interface {
        control-channel ge-1/2/4.1;
      }
    }
  }
}
```

## 4. Configure Ethernet OAM:

```
[edit]
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        action-profile rmep-defaults {
          default-action {
            interface-down;
          }
        }
      }
      maintenance-domain d1 {
        level 0;
        maintenance-association 100 {
          mep 1 {
            interface ge-1/0/1;
            remote-mep 2 {
              action-profile rmep-defaults;
            }
          }
        }
      }
      maintenance-domain d2 {
        level 0;
        maintenance-association 100 {
          mep 1 {
            interface ge-1/2/4;
            remote-mep 2 {
              action-profile rmep-defaults;
            }
          }
        }
      }
    }
  }
}
```

## Router 2 Configuration

To configure Router 2:

1. Configure the interfaces:

```
[edit]
interfaces {
  ge-1/0/2 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
  ge-1/2/1 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 1 {
      encapsulation vlan-bridge;
      vlan-id 100;
    }
  }
  irb {
    unit 0 {
      family inet {
        address address 192.1.1.22/24;
      }
    }
  }
}
```

2. Configure the bridge domain:

```
[edit]
bridge-domains {
  bd1 {
    domain-type bridge;
    vlan-id 100;
    interface ge-1/2/1.1;
    interface ge-1/0/2.1;
    routing-interface irb.0;
  }
}
```

3. Configure the Ethernet protection group:

```
[edit]
protocols {
  protection-group {
    ethernet-ring pg102 {
      node-id 00:22:22:22:22:22;
      east-interface {
        control-channel ge-1/0/2.1;
      }
      west-interface {
```

```
        control-channel ge-1/2/1.1;
      }
    }
  }
}
```

4. Configure Ethernet OAM:

```
[edit]
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        action-profile rmep-defaults {
          default-action {
            interface-down;
          }
        }
      }
      maintenance-domain d1 {
        level 0;
        maintenance-association 100 {
          mep 2 {
            interface ge-1/2/1;
            remote-mep 1 {
              action-profile rmep-defaults;
            }
          }
        }
      }
      maintenance-domain d3 {
        level 0;
        maintenance-association 100 {
          mep 1 {
            interface ge-1/0/2;
            remote-mep 2 {
              action-profile rmep-defaults;
            }
          }
        }
      }
    }
  }
}
```

## Router 3 Configuration

To configure Router 3:

1. Configure the interfaces:

```
[edit]
interfaces {
  ge-1/0/4 {
    vlan-tagging;
    encapsulation flexible-ethernet-services;
```

```

        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
    ge-1/0/3 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
    irb {
        unit 0 {
            family inet {
                address 192.1.1.33/24;
            }
        }
    }
}

```

2. Configure the bridge domain:

```

[edit]
bridge-domains {
    bd1 {
        domain-type bridge;
        vlan-id 100;
        interface ge-1/0/4.1;
        interface ge-1/0/3.1;
        routing-interface irb.0;
    }
}

```

3. Configure the Ethernet protection group:

```

[edit]
protocols {
    protection-group {
        ethernet-ring pg103 {
            node-id 00:33:33:33:33:33;
            east-interface {
                control-channel ge-1/0/3.1;
            }
            west-interface {
                control-channel ge-1/0/4.1;
            }
        }
    }
}

```

4. Configure Ethernet OAM:

```

[edit]
protocols {
    oam {
        ethernet {

```

```
connectivity-fault-management {
  action-profile rmep-defaults {
    default-action {
      interface-down;
    }
  }
  maintenance-domain d2 {
    level 0;
    maintenance-association 100 {
      mep 2 {
        interface ge-1/0/4;
        remote-mep 1 {
          action-profile rmep-defaults;
        }
      }
    }
  }
  maintenance-domain d3 {
    level 0;
    maintenance-association 100 {
      mep 2 {
        interface ge-1/0/3;
        remote-mep 1 {
          action-profile rmep-defaults;
        }
      }
    }
  }
}
```

**Related Documentation**

- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Ring Protection on page 737](#)
- [Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 763](#)
- [Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition on page 765](#)

---

## Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers

---

MX Series routers support Ethernet ring protection (ERP) to help achieve high reliability and network stability. ERP is used in router or bridge networks to protect against link failure. A single-ring topology is configured that uses one specific link called a ring protection link (RPL) to protect the whole ring. When all links are up and running, the RPL blocks traffic and remains idle. However, if a link fails, the RPL routes traffic to bypass the failure on the ring.

MX Series routers now support ERP ring instances. Whereas traffic in a ring topology follows the same path, traffic within a ring instance uses data channels to allow some

traffic to pass through one path while other traffic can follow a different one. Dividing traffic in this way supports traffic load-balancing in the ring.

This example describes how to use ERP with ring instances to load-balance traffic while still providing network protection from link failure:

- [Requirements on page 747](#)
- [Overview and Topology on page 747](#)
- [Configuration on page 750](#)
- [Verification on page 758](#)

## Requirements

This example uses the following hardware and software components:

- Two MX Series routers acting as core switches
- One MX Series router acting as an aggregation switch
- Junos OS Release 10.2 or later for MX Series routers

## Overview and Topology

[Figure 51 on page 748](#) displays the topology for this example. The topology contains three MX Series routers. CS1 and CS2 act as core routers in the topology, and AS1 acts as an aggregation switch. Each router has two ring instances, ring-1 and ring-2. All nodes on the ring coordinate protection activities by exchanging messages through the Ethernet ring automatic protection switching (R-APS) messaging protocol. Each ring instance has an RPL owner. The ring-1 RPL owner is CS1; the ring-2 RPL owner is CS2. The RPL owners block or unblock the RPL as conditions require and initiate R-APS messages.

Each ring instance has two interface ports (an east interface and a west interface) that participate in the instance. Interface **ge-2/0/8.0**, the west interface on CS2, is the ring protection link end where ring-2's RPL terminates. Interface **ge-3/2/4.0**, the east interface on CS1, is the ring protection link end where ring-1's RPL terminates.

Each ring instance has a data channel. A data channel is a group of bridge domain virtual LAN (VLAN) IDs. All VLAN IDs within the same ring interface share the same data-forwarding properties controlled by the ERP. The data channel on ring-1 is [200, 300]. The data channel on ring-2 is [500, 600].

Two customer site switches are connected to AS1. Customer site 1 uses VLANs 200 and 300. Customer site 2 uses VLANs 500 and 600.

Figure 51: ERP with Multiple Protection Instances Configured on Three MX Series Routers

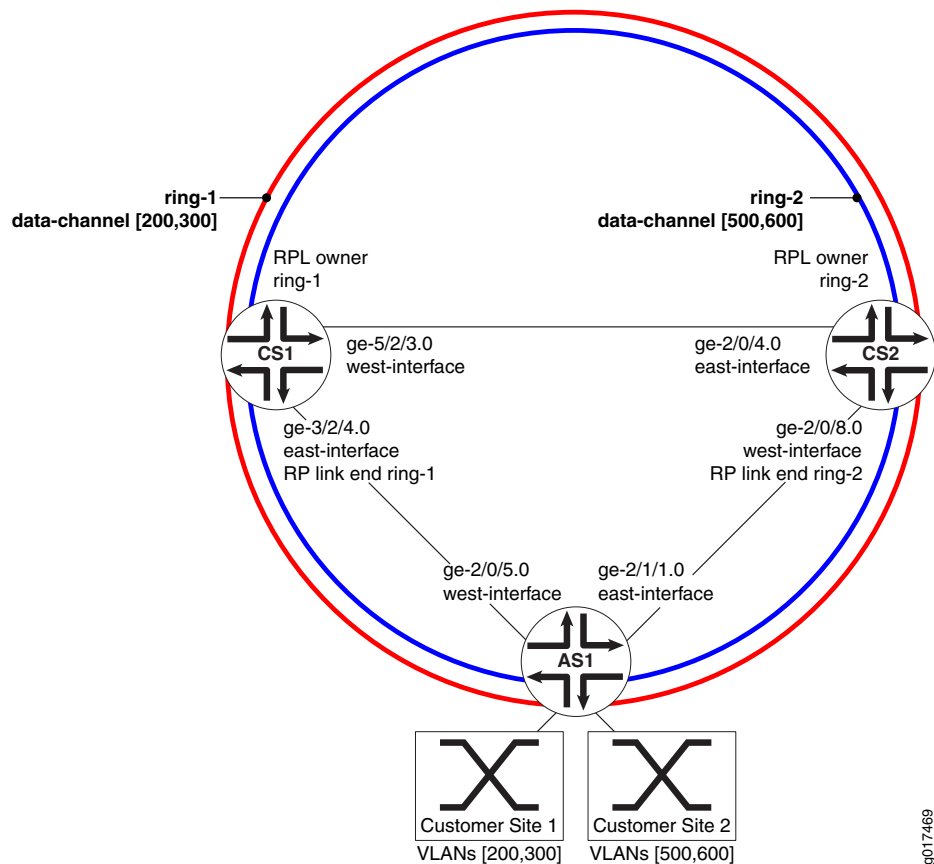


Table 64 on page 748 describes the components of the example topology.

Table 64: Components of the Network Topology

Property	Settings
Ring instances	<ul style="list-style-type: none"> <li>ring-1—Data channel [200,300]</li> <li>ring-2—Data channel [500,600]</li> </ul>
Customer sites	<p>Two customer sites are connected to AS 1:</p> <ul style="list-style-type: none"> <li>Customer site 1, VLAN 200 and VLAN 300</li> <li>Customer site 2, VLAN 500 and VLAN 600</li> </ul>



Table 64: Components of the Network Topology (*continued*)

Property	Settings
CS1 router	<p>CS1 has the following protection group properties:</p> <ul style="list-style-type: none"> <li>• RPL owner—<b>ring-1</b>.</li> <li>• East interface—<b>ge-3/2/4.0</b>.</li> <li>• West interface—<b>ge-5/2/3.0</b>.</li> <li>• Data channel for <b>ring-1</b>—<b>VLAN 200, VLAN 300</b>.</li> <li>• Data channel for <b>ring-2</b>—<b>VLAN 500, VLAN 600</b>.</li> <li>• Ring protection link end for <b>ring-1</b>—<b>ge-3/2/4.0</b>.</li> </ul> <p>CS1 has the following routing and bridging properties:</p> <ul style="list-style-type: none"> <li>• Routing instance—<b>vs</b>.</li> <li>• Bridge domains: <ul style="list-style-type: none"> <li>• <b>bd100</b> is associated with <b>vlan-id 100</b>.</li> <li>• <b>bd101</b> is associated with <b>vlan-id 101</b>.</li> <li>• <b>bd200</b> is associated with <b>vlan-id 200</b>.</li> <li>• <b>bd300</b> is associated with <b>vlan-id 300</b>.</li> <li>• <b>bd500</b> is associated with <b>vlan-id 500</b>.</li> <li>• <b>bd600</b> is associated with <b>vlan-id 600</b>.</li> </ul> </li> </ul>
CS2 router	<p>CS2 has the following protection group properties:</p> <ul style="list-style-type: none"> <li>• RPL owner—<b>ring-2</b>.</li> <li>• East interface—<b>ge-2/0/4.0</b>.</li> <li>• West interface—<b>ge-2/0/8.0</b>.</li> <li>• Ring protection link end for <b>ring-2</b>—<b>ge-2/0/8.0</b>.</li> <li>• Data channel for <b>ring-1</b>—<b>VLAN 200, VLAN 300</b>.</li> <li>• Data channel for <b>ring-2</b>—<b>VLAN 500, VLAN 600</b>.</li> </ul> <p>CS2 has the following bridging properties:</p> <ul style="list-style-type: none"> <li>• <b>bd100</b> is associated with <b>vlan-id 100</b>.</li> <li>• <b>bd101</b> is associated with <b>vlan-id 101</b>.</li> <li>• <b>bd200</b> is associated with <b>vlan-id 200</b>.</li> <li>• <b>bd300</b> is associated with <b>vlan-id 300</b>.</li> <li>• <b>bd500</b> is associated with <b>vlan-id 500</b>.</li> <li>• <b>bd600</b> is associated with <b>vlan-id 600</b>.</li> </ul>

Table 64: Components of the Network Topology (*continued*)

Property	Settings
AS1 router	<p>AS1 has the following protection group properties:</p> <ul style="list-style-type: none"> <li>• East interface—<b>ge-2/0/5.0</b>.</li> <li>• West interface—<b>ge-2/1/1.0</b>.</li> <li>• Data channel for <b>ring-1</b>—<b>VLAN 200, VLAN 300</b>.</li> <li>• Data channel for <b>ring-2</b>—<b>VLAN 500, VLAN 600</b>.</li> </ul> <p>AS1 has the following bridging properties:</p> <ul style="list-style-type: none"> <li>• <b>bd100</b> is associated with <b>vlan-id 100</b>.</li> <li>• <b>bd101</b> is associated with <b>vlan-id 101</b>.</li> <li>• <b>bd200</b> is associated with <b>vlan-id 200</b>.</li> <li>• <b>bd300</b> is associated with <b>vlan-id 300</b>.</li> <li>• <b>bd500</b> is associated with <b>vlan-id 500</b>.</li> <li>• <b>bd600</b> is associated with <b>vlan-id 600</b>.</li> </ul>

## Configuration

To enable ERP with ring instances on CS1, CS2, and AS1, perform these tasks:

- [Configuring ERP on CS1 on page 750](#)
- [Configuring ERP on CS2 on page 753](#)
- [Configuring ERP on AS1 on page 756](#)

### Configuring ERP on CS1

#### CLI Quick Configuration

To quickly configure CS1 for ERP, copy the following commands and paste them into the switch terminal window of CS1:

```
[edit]
set interfaces ge-3/2/4 vlan-tagging
set interfaces ge-3/2/4 unit 0 family bridge interface-mode trunk
set interfaces ge-3/2/4 unit 0 family bridge vlan-id-list 100-1000
set interfaces ge-5/2/3 vlan-tagging
set interfaces ge-5/2/3 unit 0 family bridge interface-mode trunk
set interfaces ge-5/2/3 unit 0 family bridge vlan-id-list 100-1000
set protocols protection-group ethernet-ring ring-1 ring-protection-link-owner
set protocols protection-group ethernet-ring ring-1 east-interface control-channel ge-3/2/4.0
set protocols protection-group ethernet-ring ring-1 east-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 east-interface ring-protection-link-end
set protocols protection-group ethernet-ring ring-1 west-interface control-channel ge-5/2/3.0
set protocols protection-group ethernet-ring ring-1 west-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 data-channel vlan [200, 300]
set protocols protection-group ethernet-ring ring-2 east-interface control-channel ge-3/2/4.0
set protocols protection-group ethernet-ring ring-2 east-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 west-interface control-channel ge-5/2/3.0
set protocols protection-group ethernet-ring ring-2 west-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 data-channel vlan [500, 600]
set routing-instances vs instance-type virtual-switch
set routing-instances vs interface ge-3/2/4.0
set routing-instances vs interface ge-5/2/3.0
set routing-instances vs bridge-domains bd101 vlan-id 101
```

```

set routing-instances vs bridge-domains bd200 vlan-id 200
set routing-instances vs bridge-domains bd300 vlan-id 300
set routing-instances vs bridge-domains bd500 vlan-id 500
set routing-instances vs bridge-domains bd600 vlan-id 600

```

**Step-by-Step Procedure** To configure ERP on CS1:

1. Configure the trunk interface **ge-3/2/4** to connect CS1 to CS2 and the trunk interface **ge-5/2/3** to connect CS1 to AS, and configure the **family** statement as **bridge** with a VLAN ID list of 100 through 1000:

```

[edit interfaces]
user@cs1# set ge-3/2/4 vlan-tagging
user@cs1# set ge-3/2/4 unit 0 family bridge interface-mode trunk
user@cs1# set ge-3/2/4 unit 0 family bridge vlan-id-list 100-1000
user@cs1# set ge-5/2/3 vlan-tagging
user@cs1# set ge-5/2/3 unit 0 family bridge interface-mode trunk
user@cs1# set ge-5/2/3 unit 0 family bridge vlan-id-list 100-1000

```

2. Enable ERP, specifying the control channels and data channels for **ring-1** and **ring-2**, and configure **ring-1** as the ring protection link owner:



**NOTE:** Always configure the east-interface statement first, before configuring the west-interface statement.

```

[edit protection-group]
user@cs1# set ethernet-ring ring-1 ring-protection-link-owner
user@cs1# set ethernet-ring ring-1 east-interface control-channel ge-3/2/4.0
user@cs1# set ethernet-ring ring-1 east-interface control-channel vlan 100
user@cs1# set ethernet-ring ring-1 east-interface ring-protection-link-end
user@cs1# set ethernet-ring ring-1 west-interface control-channel ge-5/2/3.0
user@cs1# set ethernet-ring ring-1 west-interface control-channel vlan 100
user@cs1# set ethernet-ring ring-1 data-channel vlan [200, 300]
user@cs1# set ethernet-ring ring-2 east-interface control-channel ge-3/2/4.0
user@cs1# set ethernet-ring ring-2 east-interface control-channel vlan 101
user@cs1# set ethernet-ring ring-2 west-interface control-channel ge-5/2/3.0
user@cs1# set ethernet-ring ring-2 west-interface control-channel vlan 101
user@cs1# set ethernet-ring ring-2 data-channel vlan [500, 600]

```

3. Configure the routing instance, the bridge domains, and the VLAN IDs associated with each bridge domain:

```

[edit routing-instances]
user@cs1# set vs instance-type virtual-switch
user@cs1# set vs interface ge-3/2/4.0
user@cs1# set vs interface ge-5/2/3.0
user@cs1# set vs bridge-domains bd100 vlan-id 100
user@cs1# set vs bridge-domains bd101 vlan-id 101
user@cs1# set vs bridge-domains bd200 vlan-id 200
user@cs1# set vs bridge-domains bd300 vlan-id 300
user@cs1# set vs bridge-domains bd500 vlan-id 500
user@cs1# set vs bridge-domains bd600 vlan-id 600

```

**Results** Check the results of the configuration:

```

user@cs1> show configuration
interfaces {
  ge-3/2/4 {

```

```
vlan-tagging;
unit 0 {
    family bridge {
        interface-mode trunk;
        vlan-id-list 100-1000;
    }
}
ge-5/2/3 {
    vlan-tagging;
    unit 0 {
        family bridge {
            interface-mode trunk;
            vlan-id-list 100-1000;
        }
    }
}
protocols {
    protection-group {
        ethernet-ring ring-1 {
            east-interface {
                control-channel {
                    ge-3/2/4.0;
                    vlan 100;
                }
            }
            ring-protection-link-end;
        }
        west-interface {
            control-channel {
                ge-5/2/3.0;
                vlan 100;
            }
        }
        data-channel {
            vlan [ 200 300 ];
        }
    }
}
    protection-group {
        ethernet-ring ring-2 {
            east-interface {
                control-channel {
                    ge-3/2/4.0;
                    vlan 101;
                }
            }
            west-interface {
                control-channel {
                    ge-5/2/3.0;
                    vlan 101;
                }
            }
            data-channel {
                vlan [ 500 600 ];
            }
        }
    }
}
```

```

    }
  }
  routing-instances {
    vs {
      instance-type virtual-switch;
      interface ge-3/2/4.0;
      interface ge-5/2/3.0;
      bridge-domains {
        bd100 {
          vlan-id 100;
        }
        bd101 {
          vlan-id 101;
        }
        bd200 {
          vlan-id 200;
        }
        bd300 {
          vlan-id 300;
        }
        bd500 {
          vlan-id 500;
        }
        bd600 {
          vlan-id 600;
        }
      }
    }
  }
}

```

### Configuring ERP on CS2

#### CLI Quick Configuration

To quickly configure CS2 for ERP, copy the following commands and paste them into the switch terminal window of CS2:

```

[edit]
set interfaces ge-2/0/4 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/4 unit 0 family bridge vlan-id-list 100-1000
set interfaces ge-2/0/8 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/8 unit 0 family bridge vlan-id-list 100-1000
set protocols protection-group ethernet-ring ring-1 east-interface control-channel ge-2/0/4.0
set protocols protection-group ethernet-ring ring-1 east-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 west-interface control-channel ge-2/0/8.0
set protocols protection-group ethernet-ring ring-1 west-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 data-channel vlan [200, 300]
set protocols protection-group ethernet-ring ring-2 ring-protection-link-owner
set protocols protection-group ethernet-ring ring-2 east-interface control-channel ge-2/0/4.0
set protocols protection-group ethernet-ring ring-2 east-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 west-interface control-channel ge-2/0/8.0
set protocols protection-group ethernet-ring ring-2 west-interface ring-protection-link-end
set protocols protection-group ethernet-ring ring-2 west-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 data-channel vlan [500, 600]
set bridge-domains bd100 vlan-id 100
set bridge-domains bd101 vlan-id 101
set bridge-domains bd200 vlan-id 200
set bridge-domains bd300 vlan-id 300

```

```
set bridge-domains bd500 vlan-id 500
set bridge-domains bd600 vlan-id 600
```

### Step-by-Step Procedure

To configure ERP on CS2:

1. Configure the trunk interface **ge-2/0/4** to connect CS2 to CS1 and trunk interface **ge-2/0/8** to connect CS2 to CS1, and configure the **family** statement as **bridge** with a VLAN ID list of 100 through 1000:

```
[edit interfaces]
user@cs2# set ge-2/0/4 unit 0 family bridge interface-mode trunk
user@cs2# set ge-2/0/4 unit 0 family bridge vlan-id-list 100-1000
user@cs2# set ge-2/0/8 unit 0 family bridge interface-mode trunk
user@cs2# set ge-2/0/8 unit 0 family bridge vlan-id-list 100-1000
```

2. Enable ERP, specifying the control channels and data channels for **ring-1** and **ring-2**, and configure **ring-2** as the ring protection link owner:



**NOTE:** Always configure the east-interface statement first, before configuring the west-interface statement.

```
[edit protection-group]
user@cs2# set ethernet-ring ring-1 east-interface control-channel ge-2/0/4.0
user@cs2# set ethernet-ring ring-1 east-interface control-channel vlan 100
user@cs2# set ethernet-ring ring-1 west-interface control-channel ge-2/0/8.0
user@cs2# set ethernet-ring ring-1 west-interface control-channel vlan 100
user@cs2# set ethernet-ring ring-2 data-channel vlan [200, 300]
user@cs2# set ethernet-ring ring-2 east-interface control-channel ge-2/0/4.0
user@cs2# set ethernet-ring ring-2 east-interface control-channel vlan 101
user@cs2# set ethernet-ring ring-2 ring-protection-link-owner
user@cs2# set ethernet-ring ring-2 west-interface control-channel ge-2/0/8.0
user@cs2# set ethernet-ring ring-2 west-interface control-channel vlan 101
user@cs2# set ethernet-ring ring-2 west-interface ring-protection-link-end
user@cs2# set ethernet-ring ring-2 data-channel vlan [500, 600]
```

3. Configure the routing instance, the bridge domains, and the VLAN IDs associated with each bridge domain:

```
[edit bridge-domains]
user@cs2# set bd100 vlan-id 100
user@cs2# set bd101 vlan-id 101
user@cs2# set bd200 vlan-id 200
user@cs2# set bd300 vlan-id 300
user@cs2# set bd500 vlan-id 500
user@cs2# set bd600 vlan-id 600
```

**Results** Check the results of the configuration:

```
user@cs2> show configuration
interfaces {
  ge-2/0/4 {
    unit 0 {
      family bridge {
        interface-mode trunk;
        vlan-id-list 100-1000;
      }
    }
  }
}
```

```
}
ge-2/0/8 {
  unit 0 {
    family bridge {
      interface-mode trunk;
      vlan-id-list 100-1000;
    }
  }
}
protocols {
  protection-group {
    ethernet-ring ring-1 {
      east-interface {
        control-channel {
          ge-2/0/4.0;
          vlan 100;
        }
      }
      west-interface {
        control-channel {
          ge-2/0/8.0;
          vlan 100;
        }
      }
      data-channel {
        vlan [200, 300];
      }
    }
  }
}
ethernet-ring ring-2 {
  east-interface {
    control-channel {
      ge-2/0/4.0;
      vlan 101;
    }
  }
  west-interface {
    control-channel {
      ge-2/0/8.0;
      vlan 101;
    }
  }
  ring-protection-link-end;
}
data-channel {
  vlan [500, 500];
}
}
bridge-domains {
  bd100 {
    vlan-id 100;
  }
  bd101 {
    vlan-id 101;
  }
  bd200 {
```

```

        vlan-id 200;
    }
    bd300 {
        vlan-id 300;
    }
    bd500 {
        vlan-id 500;
    }
    bd600 {
        vlan-id 600;
    }
}
}

```

### Configuring ERP on AS1

#### CLI Quick Configuration

To quickly configure AS1 for ERP, copy the following commands and paste them into the switch terminal window of AS1:

```

[edit]
set interfaces ge-2/0/5 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/5 unit 0 family bridge vlan-id-list 100-1000
set interfaces ge-2/1/1 unit 0 family bridge interface-mode trunk
set interfaces ge-2/1/1 unit 0 family bridge vlan-id-list 100-1000
set protocols protection-group ethernet-ring ring-1 east-interface control-channel ge-2/0/5.0
set protocols protection-group ethernet-ring ring-1 east-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 west-interface control-channel ge-2/1/1.0
set protocols protection-group ethernet-ring ring-1 west-interface control-channel vlan 100
set protocols protection-group ethernet-ring ring-1 data-channel vlan [200, 300]
set protocols protection-group ethernet-ring ring-2 east-interface control-channel ge-2/0/5.0
set protocols protection-group ethernet-ring ring-2 east-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 west-interface control-channel ge-2/1/1.0
set protocols protection-group ethernet-ring ring-2 west-interface control-channel vlan 101
set protocols protection-group ethernet-ring ring-2 data-channel vlan [500, 600]
set bridge-domains bd100 vlan-id 100
set bridge-domains bd101 vlan-id 101
set bridge-domains bd200 vlan-id 200
set bridge-domains bd300 vlan-id 300
set bridge-domains bd500 vlan-id 500
set bridge-domains bd600 vlan-id 600

```

#### Step-by-Step Procedure

To configure ERP on AS1:

1. Configure the trunk interface **ge-2/0/5** to connect CS2 to CS1 and trunk interface **ge-2/1/1** to connect CS2 to CS1, and configure the **family** statement as **bridge** with a VLAN ID list of 100 through 1000:

```

[edit interfaces]
user@as1# set ge-2/0/5 unit 0 family bridge interface-mode trunk
user@as1# set ge-2/0/5 unit 0 family bridge vlan-id-list 100-1000
user@as1# set ge-2/1/1 unit 0 family bridge interface-mode trunk
user@as1# set ge-2/1/1 unit 0 family bridge vlan-id-list 100

```

2. Enable ERP, specifying the control channels and data channels for **ring-1** and **ring-2**:



**NOTE:** Always configure the east-interface statement first, before configuring the west-interface statement.



- ```
[edit protection-group]
user@as1# set ethernet-ring ring-1 east-interface control-channel ge-2/0/5.0
user@as1# set ethernet-ring ring-1 east-interface control-channel vlan 100
user@as1# set ethernet-ring ring-1 west-interface control-channel ge-2/1/1.0
user@as1# set ethernet-ring ring-1 west-interface control-channel vlan 100
user@as1# set ethernet-ring ring-2 east-interface control-channel ge-2/0/5.
user@as1# set ethernet-ring ring-2 east-interface control-channel vlan 101
user@as1# set ethernet-ring ring-2 west-interface control-channel ge-2/1/1.0
user@as1# set ethernet-ring ring-2 west-interface control-channel vlan 101
user@as1# set ethernet-ring ring-2 data-channel vlan [500, 600]
```
3. Configure the routing instance, the bridge domains, and the VLAN IDs associated with each bridge domain:

```
[edit bridge-domains]
user@as1# set bd100 vlan-id 100
user@as1# set bd101 vlan-id 101
user@as1# set bd200 vlan-id 200
user@as1# set bd300 vlan-id 300
user@as1# set bd500 vlan-id 500
user@as1# set bd600 vlan-id 600
```

**Results** Check the results of the configuration:

```
user@as1> show configuration
interfaces {
  ge-2/0/5 {
    unit 0 {
      family bridge {
        interface-mode trunk;
        vlan-id-list 100-1000
      }
    }
  }
  ge-2/1/1 {
    unit 0 {
      family bridge {
        interface-mode trunk;
        vlan-id-list 100-1000
      }
    }
  }
}
protocols {
  protection-group {
    ethernet-ring ring-1 {
      east-interface {
        control-channel {
          ge-2/0/5.0;
          vlan 100;
        }
      }
      west-interface {
        control-channel {
          ge-2/1/1.0;
          vlan 100;
        }
      }
      data-channel {
```

```
        vlan [200, 300];
    }
}
}
protection-group {
    ethernet-ring ring-2 {
        east-interface {
            control-channel {
                ge-2/0/5.0;
                vlan 101;
            }
        }
        west-interface {
            control-channel {
                ge-2/1/1.0;
                vlan 101;
            }
        }
        data-channel {
            vlan [500, 600];
        }
    }
}
bridge-domains {
    bd100 {
        vlan-id 100;
    }
    bd101 {
        vlan-id 101;
    }
    bd200 {
        vlan-id 200;
    }
    bd300 {
        vlan-id 300;
    }
    bd500 {
        vlan-id 500;
    }
    bd600 {
        vlan-id 600;
    }
}
}
```

## Verification

To confirm that the ERP configuration for multiple ring instances is operating, perform these tasks:

- [Verifying the Ethernet Protection Ring on CS1 on page 759](#)
- [Verifying the Data Channel CS1 on page 759](#)
- [Verifying the VLANs on CS1 on page 760](#)

- Verifying the Ethernet Protection Ring on CS2 on page 760
- Verifying the Data Channel CS2 on page 761
- Verifying the VLANs on CS2 on page 761
- Verifying the Ethernet Protection Ring on AS1 on page 762
- Verifying the Data Channels on AS1 on page 762
- Verifying the VLANs on AS1 on page 763

### Verifying the Ethernet Protection Ring on CS1

**Purpose** Verify that ERP is enabled on CS1.

**Action** Show the status of the ring automatic protection switching (R-APS) messages to determine if there is a ring failure:

```
user@cs1>show protection-group ethernet-ring aps
```

| Ethernet<br>Node ID | Ring Name | Request/state | No Flush | Ring Protection | Link Blocked | Originator | Remote |
|---------------------|-----------|---------------|----------|-----------------|--------------|------------|--------|
| ring-1              |           | NR            | No       | Yes             |              | Yes        |        |
| ring-2              |           | NR            | No       | Yes             |              | No         |        |
| 13:22:af:31:fc:00   |           |               |          |                 |              |            |        |

**Meaning** The output displayed shows that protection groups **ring-1** and **ring-2** have a **Request/state** of **NR**, meaning there is no request for APS on the ring. If a **Request/state** of **SF** is displayed, it indicates there is a signal failure on the ring. The output also shows that the ring protection link is not blocked. The **No Flush** field displays **No**, indicating that MAC addresses will be flushed when the ring nodes receive this message first time. A value of **Yes** would indicate MAC address flushing is not needed. The **Originator** field for **ring-1** displays **yes**, indicating that this node is an R-APS originator.

### Verifying the Data Channel CS1

**Purpose** Verify the forwarding state of the data channel.

**Action** List the interfaces acting as the control channels and their respective data channels (represented by the Spanning Tree Protocol (STP) index number):

```
user@cs1>show protection-group ethernet-ring data-channel
```

```
Ethernet ring data channel parameters for protection group ring-1
```

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-3/2/4  | 122       | forwarding    |
| ge-5/2/3  | 123       | forwarding    |

```
Ethernet ring data channel parameters for protection group ring-2
```

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-3/2/4  | 124       | discarding    |
| ge-5/2/3  | 125       | forwarding    |

**Meaning** The output displayed shows the STP index number used by each interface in ring instances **ring-1** and **ring-2**. The STP index controls the forwarding behavior for a set of VLANs on the data channel of a ring instance on a ring interface. For ring instances, there are multiple STP index numbers (here representing VLANs 200, 300, 500, and 600). The **Forward State** shows whether the data channel is **forwarding** or **discarding** traffic.

### Verifying the VLANs on CS1

**Purpose** Verify the data channel logical interfaces and the VLAN IDs controlled by a ring instance data channel.

**Action** List dynamic VLAN membership:

```
user@cs1>show protection-group ethernet-ring vlan
```

Ethernet ring IFBD parameters for protection group ring-1

| Interface | Vlan | STP Index | Bridge Domain |
|-----------|------|-----------|---------------|
| ge-3/2/4  | 200  | 122       | vs/bd200      |
| ge-5/2/3  | 200  | 123       | vs/bd200      |
| ge-3/2/4  | 300  | 122       | vs/bd300      |
| ge-5/2/3  | 300  | 123       | vs/bd300      |

Ethernet ring IFBD parameters for protection group ring-2

| Interface | Vlan | STP Index | Bridge Domain |
|-----------|------|-----------|---------------|
| ge-3/2/4  | 500  | 124       | vs/bd500      |
| ge-5/2/3  | 500  | 125       | vs/bd500      |
| ge-3/2/4  | 600  | 124       | vs/bd600      |
| ge-5/2/3  | 600  | 125       | vs/bd600      |

**Meaning** The output displayed shows the ring interfaces **ge-3/2/4** and **ge-5/2/3** in protection groups **ring-1** and **ring-2**. For **ring-1**, VLAN 200 and VLAN 300 are being supported on both **STP Index 122** and **123** on bridge domains **bd200** and **bd300**. For **ring-2**, VLAN 500 and VLAN 600 are being supported on both **STP Index 124** and **125** on bridge domains **bd500** and **bd600**. The data channel controls the traffic on the VLAN IDs to facilitate load balancing.

### Verifying the Ethernet Protection Ring on CS2

**Purpose** Verify that ERP is enabled on CS2.

**Action** Show the status of the ring APS (R-APS) messages to determine if there is a ring failure:

```
user@cs2>show protection-group ethernet-ring aps
```

| Ethernet Ring Name<br>Node ID | Request/state | No Flush | Ring Protection | Originator | Remote |
|-------------------------------|---------------|----------|-----------------|------------|--------|
| Ring-1<br>00:21:59:03:ff:d0   | NR            | No       | No              | No         | No     |
| Ring-2                        | NR            | No       | Yes             | Yes        | Yes    |

**Meaning** The output displayed shows that protection groups **ring-1** and **ring-2** have a **Request/state** of **NR**, meaning there is no request for APS on the ring. If a **Request/state** of **SF** is displayed,

it indicates there is a signal failure on the ring. The output also shows that the ring protection link is not blocked. The **No Flush** field displays **No**, indicating that MAC addresses will be flushed when the ring nodes receive this message first time. A value of **Yes** would indicate MAC address flushing is not needed. The **Originator** field for **ring-1** displays **yes**, indicating that this node is an R-APS originator. The **Originator** field for **ring-2** displays **No**, indicating that this node is not an R-APS originator.

### Verifying the Data Channel CS2

**Purpose** Verify the forwarding state of the data channel.

**Action** List the interfaces acting as the control channels and their respective data channels (represented by the STP index number):

```
user@cs2> show protection-group ethernet-ring data-channel
Ethernet ring data channel parameters for protection group ring-1
```

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-2/0/4  | 44        | forwarding    |
| ge-2/0/8  | 45        | forwarding    |

```
Ethernet ring data channel parameters for protection group ring-2
```

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-2/0/4  | 46        | forwarding    |
| ge-2/0/8  | 47        | discarding    |

**Meaning** The output displayed shows the STP index number used by each interface in ring instances **ring-1** and **ring-2**. The STP index controls the forwarding behavior for a set of VLANs on the data channel of a ring instance on a ring interface. For ring instances, there are multiple STP index numbers (here representing VLANs 200, 300, 500, and 600). The **Forward State** shows whether the data channel is **forwarding** or **discarding** traffic.

### Verifying the VLANs on CS2

**Purpose** Verify the data channel logical interfaces and the VLAN IDs controlled by a ring instance data channel.

**Action** List dynamic VLAN membership:

```
user@cs2> show protection-group ethernet-ring vlan
Ethernet ring IFBD parameters for protection group ring-1
```

| Interface | Vlan | STP Index | Bridge Domain        |
|-----------|------|-----------|----------------------|
| ge-2/0/4  | 200  | 44        | default-switch/bd200 |
| ge-2/0/8  | 200  | 45        | default-switch/bd200 |
| ge-2/0/4  | 300  | 44        | default-switch/bd300 |
| ge-2/0/8  | 300  | 45        | default-switch/bd300 |

```
Ethernet ring IFBD parameters for protection group ring-2
```

| Interface | Vlan | STP Index | Bridge Domain        |
|-----------|------|-----------|----------------------|
| ge-2/0/4  | 500  | 46        | default-switch/bd500 |
| ge-2/0/8  | 500  | 47        | default-switch/bd500 |

|          |     |    |                      |
|----------|-----|----|----------------------|
| ge-2/0/4 | 600 | 46 | default-switch/bd600 |
| ge-2/0/8 | 600 | 47 | default-switch/bd600 |

**Meaning** The output displayed shows the ring interfaces **ge-2/0/4** and **ge-2/0/8** in protection groups **ring-1** and **ring-2**. For **ring-1**, VLAN 200 and VLAN 300 are being supported on both **STP Index 44** and **45** on bridge domains **bd200** and **bd300**. For **ring-2**, VLAN 500 and VLAN 600 are being supported on both **STP Index 46** and **47** on bridge domains **bd500** and **bd600**. The data channel controls the traffic on the VLAN IDs to facilitate load balancing.

### Verifying the Ethernet Protection Ring on AS1

**Purpose** Verify that ERP is enabled on AS1.

**Action** Show the status of the ring APS (R-APS) messages to determine if there is a ring failure:

```
user@as1> show protection-group ethernet-ring aps
```

| Ethernet Ring Name<br>Node ID | Request/state | No Flush | Ring Protection     | Originator | Remote |
|-------------------------------|---------------|----------|---------------------|------------|--------|
| Ring-1<br>00:21:59:03:ff:d0   | NR            | No       | Link Blocked<br>Yes | No         |        |
| Ring-2<br>13:22:af:31:fc:00   | NR            | No       | Yes                 | No         |        |

**Meaning** The output displayed shows that protection groups **ring-1** and **ring-2** have a **Request/state** of **NR**, meaning there is no request for APS on the ring. If a **Request/state** of **SF** is displayed, it indicates there is a signal failure on the ring. The output also shows that the ring protection link is not blocked. The **No Flush** field displays **No**, indicating that MAC addresses will be flushed when the ring nodes receive this message first time. A value of **Yes** would indicate MAC address flushing is not needed. The **Originator** field for **ring-1** and **ring-2** displays **No**, indicating that this node is not the R-APS originator.

### Verifying the Data Channels on AS1

**Purpose** Verify the forwarding state of the data channel.

**Action** List the interfaces acting as the control channels and their respective data channels (represented by the STP index number):

```
user@as1> show protection-group ethernet-ring data-channel
```

Ethernet ring data channel parameters for protection group ring-1

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-2/0/5  | 22        | forwarding    |
| ge-2/1/1  | 23        | forwarding    |

Ethernet ring data channel parameters for protection group ring-2

| Interface | STP index | Forward State |
|-----------|-----------|---------------|
| ge-2/0/5  | 24        | forwarding    |
| ge-2/1/1  | 25        | forwarding    |

**Meaning** The output displayed shows the STP index number used by each interface in ring instances **ring-1** and **ring-2**. The STP index controls the forwarding behavior for a set of VLANs on the data channel of a ring instance on a ring interface. For ring instances, there are multiple STP index numbers (here representing VLANs 200, 300, 500, and 600). The **Forward State** shows whether the data channel is **forwarding** or **discarding** traffic. All data channels are forwarding traffic.

### Verifying the VLANs on AS1

**Purpose** Verify the data channel logical interfaces and the VLAN IDs controlled by a ring instance data channel.

**Action** List dynamic VLAN membership:

```
user@as1>show protection-group ethernet-ring vlan
```

Ethernet ring IFBD parameters for protection group ring-1

| Interface | Vlan | STP Index | Bridge Domain        |
|-----------|------|-----------|----------------------|
| ge-2/0/5  | 200  | 22        | default-switch/bd200 |
| ge-2/1/1  | 200  | 23        | default-switch/bd200 |
| ge-2/0/5  | 300  | 22        | default-switch/bd300 |
| ge-2/1/1  | 300  | 23        | default-switch/bd300 |

Ethernet ring IFBD parameters for protection group ring-2

| Interface | Vlan | STP Index | Bridge Domain        |
|-----------|------|-----------|----------------------|
| ge-2/0/5  | 500  | 24        | default-switch/bd500 |
| ge-2/1/1  | 500  | 25        | default-switch/bd500 |
| ge-2/0/5  | 600  | 24        | default-switch/bd600 |
| ge-2/1/1  | 600  | 25        | default-switch/bd600 |

**Meaning** The output displayed shows the ring interfaces **ge-2/0/5** and **ge-2/1/1** in protection groups **ring-1** and **ring-2**. For **ring-1**, VLAN 200 and VLAN 300 are being supported on both **STP Index 22** and **23** on bridge domains **bd200** and **bd300**. For **ring-2**, VLAN 500 and VLAN 600 are being supported on both **STP Index 24** and **25** on bridge domains **bd500** and **bd600**. The data channel controls the traffic on the VLAN IDs to facilitate load-balancing.

**Related Documentation**

- [Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739](#)
- [Ethernet Ring Protection on page 737](#)

## Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation

Under normal operating conditions, when Ethernet ring protection is configured correctly, the ring protection link (RPL) owner (Router 1 in the configuration example) will see the following:

### Router 1 Operational Commands (Normal Ring Operation)

```
user@router1> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg101              NR           No       Yes
```

```
Originator Remote Node ID
Yes
```

Note that the ring protection link is blocked and the node is marked as the originator of the protection.

```
user@router1> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101
```

| Interface | Control Channel | Forward State | Ring Protection Link End |
|-----------|-----------------|---------------|--------------------------|
| ge-1/0/1  | ge-1/0/1.1      | discarding    | Yes                      |
| ge-1/2/4  | ge-1/2/4.1      | forwarding    | No                       |

```
Signal Failure Admin State
Clear          IFF ready
Clear          IFF ready
```

Note that the protection interface is discarding while the other interface is forwarding.

```
user@router1> show protection-group ethernet-ring node-state
Ethernet ring APS State Event Ring Protection Link Owner
pg101         idle     NR-RB Yes
```

```
Restore Timer Quard Timer Operation state
disabled      disabled operational
```

Note that Router 1 is the owner and timers are disabled.

```
user@router1> show protection-group ethernet-ring statistics group-name pg101
```

```
Ethernet Ring statistics for PG pg101
RAPS sent           : 1
RAPS received       : 0
Local SF happened:   : 0
Remote SF happened:  : 0
NR event happened:   : 0
NR-RB event happened: : 1
```

Note that only minimal RAPS messages have been sent to establish the ring.

Under normal operating conditions, the other routers on the ring (Router 2 and Router 3) will see the following similar output:

#### Router 2 and Router 3 Operational Commands (Normal Ring Operation)

```
user@router2> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg102              NR           No      Yes
```

```
Originator Remote Node ID
No          00:01:01:00:00:01
```

Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg102
```

| Interface | Control Channel | Forward State | Ring Protection Link End |
|-----------|-----------------|---------------|--------------------------|
| ge-1/2/1  | ge-1/2/1.1      | forwarding    | No                       |
| ge-1/0/2  | ge-1/0/2.1      | forwarding    | No                       |



```
Signal Failure Admin State
Clear          IFF ready
Clear          IFF ready
```

Note that both interfaces are forwarding. Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring node-state
Ethernet ring APS State Event Ring Protection Link Owner
pg102         idle      NR-RB No

Restore Timer Quard Timer Operation state
disabled      disabled operational
```

Note that Router 2 is not the owner. Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg102
RAPS sent                : 0
RAPS received             : 1
Local SF happened:       : 0
Remote SF happened:       : 0
NR event happened:       : 0
NR-RB event happened:    : 1
```

Router 3 will see almost identical information.

#### Related Documentation

- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Ethernet Ring Protection on page 737](#)
- [Example: Configuring Ethernet Ring Protection for MX Series Routers on page 740](#)
- [Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition on page 765](#)

## Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition

This section assumes that Ethernet ring protection is configuring correctly, that Router 1 is the ring protection link (RPL) owner, and that there is a link failure between Router 2 and Router 3 in the configuration example.

### Router 1 Operational Commands (Ring Failure Condition)

```
user@router1> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg101              SF           NO      No

Originator Remote Node ID
No          00:01:02:00:00:01
```

Note that the ring protection link is no longer blocked and the node is no longer marked as originator.

```
user@router1> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface Control Channel Forward State Ring Protection Link End
ge-1/0/1   ge-1/0/1.1        forwarding Yes
```

```
ge-1/2/4      ge-1/2/4.1      forwarding      No
```

```
Signal Failure Admin State
Clear          IFF ready
Clear          IFF ready
```

Note that the protection interface is now forwarding (so is the other interface).

```
user@router1> show protection-group ethernet-ring node-state
how protection-group ethernet-ring node-state
Ethernet ring   APS State   Event           Ring Protection Link Owner
pg101          protected   SF             Yes

Restore Timer   Quard Timer   Operation state
disabled        disabled      operational
```

Note that Router 1 has recorded the span failure (SF).

```
user@router1> show protection-group ethernet-ring statistics group-name pg101
Ethernet Ring statistics for PG pg101
RAPS sent                : 1
RAPS received            : 1
Local SF happened:       : 0
Remote SF happened:       : 1
NR event happened:        : 0
NR-RB event happened:     : 1
```

Note that the R-APS messages have recorded the remote failure.

Under a failure condition, the other routers on the ring (Router 2 and Router 3) will see the following similar output:

### Router 2 and Router 3 Operational Commands (Failure Condition)

```
user@router2> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg102              SF           No      No

Originator Remote Node ID
Yes         00:00:00:00:00:00
```

Note the failure event (SF). Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg102

Interface   Control Channel Forward State Ring Protection Link End
ge-1/2/1    ge-1/2/1.1      forwarding   No
ge-1/0/2    ge-1/0/2.1      discarding   No

Signal Failure Admin State
Clear          IFF ready
set            IFF ready
```

Note that the failed interface (**ge-1/0/2.1**) is not forwarding. Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring node-state
Ethernet ring   APS State   Event           Ring Protection Link Owner
pg102          idle       NR-RB           No
```

```
Restore Timer  Quard Timer  Operation state
disabled       disabled     operational
```

Note that Router 2 is not the owner. Router 3 will see almost identical information.

```
user@router2> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg102
RAPS sent                : 1
RAPS received             : 1
Local SF happened:        : 1
Remote SF happened:        : 0
NR event happened:        : 0
NR-RB event happened:     : 1
```

Note that the R-APS messages have recorded the remote failure. Router 3 will see almost identical information.

#### Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- [Ethernet Ring Protection on page 737](#)
- [Example: Configuring Ethernet Ring Protection for MX Series Routers on page 740](#)
- [Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 763](#)



## PART 4

# Troubleshooting Information

- [Monitoring and Troubleshooting Ethernet Interfaces on page 771](#)



## CHAPTER 35

# Monitoring and Troubleshooting Ethernet Interfaces

- [Configuring Interface Diagnostics Tools to Test the Physical Layer Connections on page 771](#)
- [Monitoring Fast Ethernet and Gigabit Ethernet Interfaces on page 777](#)
- [Performing Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces on page 786](#)
- [Locating the Fast Ethernet and Gigabit Ethernet LINK Alarm and Counters on page 800](#)
- [Troubleshooting: 10-Gigabit Ethernet Port Stuck in Down State on page 804](#)

## Configuring Interface Diagnostics Tools to Test the Physical Layer Connections

- [Configuring Loopback Testing on page 771](#)
- [Configuring BERT Testing on page 773](#)
- [Starting and Stopping a BERT Test on page 776](#)

### Configuring Loopback Testing

Loopback testing allows you to verify the connectivity of a circuit. You can configure any of the following interfaces to execute a loopback test: aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, E1, E3, NxDS0, serial, SONET/SDH, T1, and T3.

The physical path of a network data circuit usually consists of segments interconnected by devices that repeat and regenerate the transmission signal. The transmit path on one device connects to the receive path on the next device. If a circuit fault occurs in the form of a line break or a signal corruption, you can isolate the problem by using a loopback test. Loopback tests allow you to isolate segments of the circuit and test them separately.

To do this, configure a *line loopback* on one of the routers. Instead of transmitting the signal toward the far-end device, the line loopback sends the signal back to the originating router. If the originating router receives back its own Data Link Layer packets, you have verified that the problem is beyond the originating router. Next, configure a line loopback farther away from the local router. If this originating router does not receive its own Data Link Layer packets, you can assume that the problem is on one of the segments between the local router and the remote router's interface card. In this case, the next

troubleshooting step is to configure a line loopback closer to the local router to find the source of the problem.

The following types of loopback testing are supported by Junos OS:

- DCE local—Loops packets back on the local data circuit-terminating equipment (DCE).
- DCE remote—Loops packets back on the remote DCE.
- Local—Useful for troubleshooting physical PIC errors. Configuring local loopback on an interface allows transmission of packets to the channel service unit (CSU) and then to the circuit toward the far-end device. The interface receives its own transmission, which includes data and timing information, on the local router's PIC. The data received from the CSU is ignored. To test a local loopback, issue the **show interfaces interface-name** command. If PPP keepalives transmitted on the interface are received by the PIC, the **Device Flags** field contains the output **Loop-Detected**.
- Payload—Useful for troubleshooting the physical circuit problems between the local router and the remote router. A payload loopback loops data only (without clocking information) on the remote router's PIC. With payload loopback, overhead is recalculated.
- Remote—Useful for troubleshooting the physical circuit problems between the local router and the remote router. A remote loopback loops packets, including both data and timing information, back on the remote router's interface card. A router at one end of the circuit initiates a remote loopback toward its remote partner. When you configure a remote loopback, the packets received from the physical circuit and CSU are received by the interface. Those packets are then retransmitted by the PIC back toward the CSU and the circuit. This loopback tests all the intermediate transmission segments.

Table 65 on page 772 shows the loopback modes supported on the various interface types.

**Table 65: Loopback Modes by Interface Type**

| Interface                                            | Loopback Modes   | Usage Guidelines                                                                                                                                                                                                                                                     |
|------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aggregated Ethernet, Fast Ethernet, Gigabit Ethernet | Local            | "Configuring Ethernet Loopback Capability" on page 17                                                                                                                                                                                                                |
| Circuit Emulation E1                                 | Local and remote | <i>Configuring E1 Loopback Capability</i>                                                                                                                                                                                                                            |
| Circuit Emulation T1                                 | Local and remote | <i>Configuring T1 Loopback Capability</i>                                                                                                                                                                                                                            |
| E1 and E3                                            | Local and remote | <i>Configuring E1 Loopback Capability and Configuring E3 Loopback Capability</i>                                                                                                                                                                                     |
| NxDS0                                                | Payload          | <i>Configuring Channelized E1 IQ and IQE Interfaces, Configuring T1 and NxDS0 Interfaces, Configuring Channelized OC12/STM4 IQ and IQE Interfaces (SONET Mode), Configuring Channelized STM1 IQ and IQE Interfaces, and Configuring Channelized T3 IQ Interfaces</i> |



Table 65: Loopback Modes by Interface Type (*continued*)

| Interface              | Loopback Modes                           | Usage Guidelines                                                                                                                                    |
|------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Serial (V.35 and X.21) | Local and remote                         | <i>Configuring Serial Loopback Capability</i>                                                                                                       |
| Serial (EIA-530)       | DCE local, DCE remote, local, and remote | <i>Configuring Serial Loopback Capability</i>                                                                                                       |
| SONET/SDH              | Local and remote                         | <i>Configuring SONET/SDH Loopback Capability to Identify a Problem as Internal or External</i>                                                      |
| T1 and T3              | Local, payload, and remote               | <i>Configuring T1 Loopback Capability and Configuring T3 Loopback Capability</i><br><br><i>See also Configuring the T1 Remote Loopback Response</i> |

To configure loopback testing, include the **loopback** statement:

```
user@host# loopback mode;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* [aggregated-ether-options](#)]
- [edit interfaces *interface-name* [ds0-options](#)]
- [edit interfaces *interface-name* [e1-options](#)]
- [edit interfaces *interface-name* [e3-options](#)]
- [edit interfaces *interface-name* [fastether-options](#)]
- [edit interfaces *interface-name* [gigether-options](#)]
- [edit interfaces *interface-name* [serial-options](#)]
- [edit interfaces *interface-name* [sonet-options](#)]
- [edit interfaces *interface-name* [t1-options](#)]
- [edit interfaces *interface-name* [t3-options](#)]

## Configuring BERT Testing

To configure BERT:

- Configure the duration of the test.

```
[edit interfaces interface-name interface-type-options]
user@host# bert-period seconds;
```

You can configure the BERT period to last from 1 through 239 seconds on some PICs and from 1 through 240 seconds on other PICs. By default, the BERT period is 10 seconds.

- Configure the error rate to monitor when the inbound pattern is received.

```
[edit interfaces interface-name interface-type-options]
user@host# bert-error-rate rate;
```

*rate* is the bit error rate. This can be an integer from 0 through 7, which corresponds to a bit error rate from  $10^{-0}$  (1 error per bit) to  $10^{-7}$  (1 error per 10 million bits).

- Configure the bit pattern to send on the transmit path.

```
[edit interfaces interface-name interface-type-options]
user@host# bert-algorithm algorithm;
```

*algorithm* is the pattern to send in the bit stream. For a list of supported algorithms, enter a ? after the **bert-algorithm** statement; for example:

```
[edit interfaces t1-0/0/0 t1-options]
user@host# set bert-algorithm ?
Possible completions:
pseudo-2e11-o152      Pattern is 2^11 - 1 (per 0.152 standard)
pseudo-2e15-o151      Pattern is 2^15 - 1 (per 0.152 standard)
pseudo-2e20-o151      Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e20-o153      Pattern is 2^20 - 1 (per 0.153 standard)
...
```

For specific hierarchy information, see the individual interface types.



**NOTE:** The four-port E1 PIC supports only the following algorithms:

```
pseudo-2e11-o152      Pattern is 2^11 - 1 (per 0.152 standard)
pseudo-2e15-o151      Pattern is 2^15 - 1 (per 0.151 standard)
pseudo-2e20-o151      Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e23-o151      Pattern is 2^23 (per 0.151 standard)
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.



**NOTE:** The 12-port T1/E1 Circuit Emulation (CE) PIC supports only the following algorithms:

```
all-ones-repeating    Repeating one bits
all-zeros-repeating    Repeating zero bits
alternating-double-ones-zeros Alternating pairs of ones and zeros
alternating-ones-zeros Alternating ones and zeros
pseudo-2e11-o152      Pattern is 2^11 - 1 (per 0.152 standard)
pseudo-2e15-o151      Pattern is 2^15 - 1 (per 0.151 standard)
pseudo-2e20-o151      Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e7             Pattern is 2^7 - 1
pseudo-2e9-o153        Pattern is 2^9 - 1 (per 0.153 standard)
repeating-1-in-4        1 bit in 4 is set
repeating-1-in-8        1 bit in 8 is set
repeating-3-in-24       3 bits in 24 are set
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.



**NOTE:** The IQE PICs support only the following algorithms:

```
all-ones-repeating    Repeating one bits
all-zeros-repeating   Repeating zero bits
alternating-double-ones-zeros Alternating pairs of ones and zeros
alternating-ones-zeros Alternating ones and zeros
pseudo-2e9-o153      Pattern is 2^9 -1 (per 0.153 (511 type) standard)
pseudo-2e11-o152     Pattern is 2^11 -1 (per 0.152 and 0.153 (2047 type)
standards)
pseudo-2e15-o151     Pattern is 2^15 -1 (per 0.151 standard)
pseudo-2e20-o151     Pattern is 2^20 -1 (per 0.151 standard)
pseudo-2e20-o153     Pattern is 2^20 -1 (per 0.153 standard)
pseudo-2e23-o151     Pattern is 2^23 -1 (per 0.151 standard)
repeating-1-in-4      1 bit in 4 is set
repeating-1-in-8      1 bit in 8 is set
repeating-3-in-24     3 bits in 24 are set
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.



**NOTE:** BERT is supported on the PDH interfaces of the Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP and the DS3/E3 MIC. The following BERT algorithms are supported:

```
all-ones-repeating    Repeating one bits
all-zeros-repeating   Repeating zero bits
alternating-double-ones-zeros Alternating pairs of ones and zeros
alternating-ones-zeros Alternating ones and zeros
repeating-1-in-4      1 bit in 4 is set
repeating-1-in-8      1 bit in 8 is set
repeating-3-in-24     3 bits in 24 are set
pseudo-2e9-o153      Pattern is 2^9 - 1 (per 0.153 standard)
pseudo-2e11-o152     Pattern is 2^11 - 1 (per 0.152 standard)
pseudo-2e15-o151     Pattern is 2^15 - 1 (per 0.151 standard)
pseudo-2e20-o151     Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e20-o153     Pattern is 2^20 - 1 (per 0.153 standard)
pseudo-2e23-o151     Pattern is 2^23 (per 0.151 standard)
```

Table 66 on page 775 shows the BERT capabilities for various interface types.

**Table 66: BERT Capabilities by Interface Type**

| Interface                                              | T1 BERT          | T3 BERT | Comments             |
|--------------------------------------------------------|------------------|---------|----------------------|
| 12-port T1/E1<br>Circuit Emulation                     | Yes (ports 0–11) | —       | • Limited algorithms |
| 4-port<br>Channelized<br>OC3/STM1<br>Circuit Emulation | Yes (port 0–3)   | —       | • Limited algorithms |

Table 66: BERT Capabilities by Interface Type (*continued*)

| Interface                          | T1 BERT            | T3 BERT                     | Comments                                                                                                                                                                      |
|------------------------------------|--------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E1 or T1                           | Yes (port 0–3)     | Yes (port 0–3)              | <ul style="list-style-type: none"> <li>Single port at a time</li> <li>Limited algorithms</li> </ul>                                                                           |
| E3 or T3                           | Yes (port 0–3)     | Yes (port 0–3)              | <ul style="list-style-type: none"> <li>Single port at a time</li> </ul>                                                                                                       |
| Channelized OC12                   | —                  | Yes (channel 0–11)          | <ul style="list-style-type: none"> <li>Single channel at a time</li> <li>Limited algorithms</li> <li>No bit count</li> </ul>                                                  |
| Channelized STM1                   | Yes (channel 0–62) | —                           | <ul style="list-style-type: none"> <li>Multiple channels</li> <li>Only one algorithm</li> <li>No error insert</li> <li>No bit count</li> </ul>                                |
| Channelized T3 and Multichannel T3 | Yes (channel 0–27) | Yes (port 0–3 on channel 0) | <ul style="list-style-type: none"> <li>Multiple ports and channels</li> <li>Limited algorithms for T1</li> <li>No error insert for T1</li> <li>No bit count for T1</li> </ul> |

These limitations do not apply to channelized IQ interfaces. For information about BERT capabilities on channelized IQ interfaces, see *Channelized IQ and IQE Interfaces Properties*.

## Starting and Stopping a BERT Test

Before you can start the BERT test, you must disable the interface. To do this, include the **disable** statement at the `[edit interfaces interface-name]` hierarchy level:

```
[edit interfaces interface-name]
disable;
```

After you configure the BERT properties and commit the configuration, begin the test by issuing the **test interface *interface-name interface-type-bert-start*** operational mode command:

```
user@host> test interface interface-name interface-type-bert-start
```

The test runs for the duration you specify with the **bert-period** statement. If you want to terminate the test sooner, issue the **test interface *interface-name interface-type-bert-stop*** command:

```
user@host> test interface interface-name interface-type-bert-stop
```

For example:

```
user@host> test interface t3-1/2/0 t3-bert-start
user@host> test interface t3-1/2/0 t3-bert-stop
```

To view the results of the BERT test, issue the **show interfaces extensive | find BERT** command:

```
user@host> show interfaces interface-name extensive | find BERT
```

For more information about running and evaluating the results of the BERT procedure, see the [CLI Explorer](#).



**NOTE:** To exchange BERT patterns between a local router and a remote router, include the `loopback remote` statement in the interface configuration at the remote end of the link. From the local router, issue the `test interface` command.

**Related Documentation**

- [show interfaces diagnostics optics \(Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port\) on page 1528](#)

## Monitoring Fast Ethernet and Gigabit Ethernet Interfaces

- [Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces on page 777](#)
- [Monitor Fast Ethernet and Gigabit Ethernet Interfaces on page 778](#)
- [Fiber-Optic Ethernet Interface Specifications on page 785](#)

### Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces

**Purpose** To monitor Fast Ethernet and Gigabit Ethernet interfaces and begin the process of isolating interface problems when they occur.

**Action** [Table 67 on page 777](#) provides links and commands for monitoring Fast Ethernet and Gigabit Ethernet interfaces.

**Table 67: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces**

| Tasks                                                                                                                          | Command or Action                                                          |
|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>“Monitor Fast Ethernet and Gigabit Ethernet Interfaces” on page 778</b>                                                     |                                                                            |
| 1. <a href="#">Display the Status of Fast Ethernet Interfaces on page 778</a>                                                  | <code>show interfaces terse (fe*   ge*)</code>                             |
| 2. <a href="#">Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface on page 780</a>                    | <code>show interfaces (fe-fpc/pic/port   ge-fpc/pic/port)</code>           |
| 3. <a href="#">Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface on page 781</a> | <code>show interfaces (fe-fpc/pic/port   ge-fpc/pic/port) extensive</code> |
| 4. <a href="#">Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface on page 784</a>                            | <code>monitor interface (fe-fpc/pic/port   ge-fpc/pic/port)</code>         |
| 5. <a href="#">Fiber-Optic Ethernet Interface Specifications on page 785</a>                                                   |                                                                            |

**Meaning** You can use the above described commands to monitor and to display the configurations for Fast Ethernet and Gigabit Ethernet interfaces.

## Monitor Fast Ethernet and Gigabit Ethernet Interfaces

By monitoring Fast Ethernet and Gigabit Ethernet interfaces, you begin to isolate Fast Ethernet and Gigabit Ethernet interface problems when they occur.

To monitor your Fast Ethernet and Gigabit Ethernet interfaces, follow these steps:

1. [Display the Status of Fast Ethernet Interfaces on page 778](#)
2. [Display the Status of Gigabit Ethernet Interfaces on page 779](#)
3. [Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface on page 780](#)
4. [Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface on page 781](#)
5. [Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface on page 784](#)

### Display the Status of Fast Ethernet Interfaces

**Purpose** To display the status of Fast Ethernet interfaces, use the following Junos OS command-line interface (CLI) operational mode command:

**Action** `user@host> show interfaces terse (fe* | ge*)`

### Sample Output

```
user@host> show interfaces terse fe*
Interface      Admin Link Proto Local Remote
fe-2/1/0       up    up
fe-2/1/0.0     up    up   inet  10.116.115.217/29
fe-3/0/2       up    down
fe-3/0/2.0     up    down
fe-3/0/3       up    up
fe-3/0/3.0     up    up   inet  192.168.223.65/30
fe-4/1/0       down  up
fe-4/1/0.0     up    down inet  10.150.59.133/30
fe-4/1/1       up    up
fe-4/1/1.0     up    up   inet  10.150.59.129/30
fe-4/1/2       up    down
fe-4/1/2.0     up    down
```

**Meaning** The sample output lists only the Fast Ethernet interfaces. It shows the status of both the physical and logical interfaces. For a description of what the output means, see [Table 68 on page 778](#).

**Table 68: Status of Fast Ethernet Interfaces**

| Physical Interface | Logical Interface | Status Description                                                     |
|--------------------|-------------------|------------------------------------------------------------------------|
| fe-2/1/0           | fe-2/1/0.0        | This interface has both the physical and logical links up and running. |
| Admin Up           | Admin Up          |                                                                        |
| Link Up            | Link Up           |                                                                        |

Table 68: Status of Fast Ethernet Interfaces (*continued*)

| Physical Interface | Logical Interface | Status Description                                                                                                                                                                                                  |
|--------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| fe-3/0/2           | fe-3/0/2.0        | This interface has the physical link down, the link layer down, or both down ( <b>Link Down</b> ). The logical link is also down as a result.                                                                       |
| Admin Up           | Admin Up          |                                                                                                                                                                                                                     |
| Link Down          | Link Down         |                                                                                                                                                                                                                     |
| fe-4/1/0           | fe-4/1/0.0        | This interface is administratively disabled and the physical link is healthy ( <b>Link Up</b> ), but the logical interface is not established. The logical interface is down because the physical link is disabled. |
| Admin Down         | Admin Up          |                                                                                                                                                                                                                     |
| Link Up            | Link Down         |                                                                                                                                                                                                                     |
| fe-4/1/2           | fe-4/1/2.0        | This interface has both the physical and logical links down.                                                                                                                                                        |
| Admin Up           | Admin Up          |                                                                                                                                                                                                                     |
| Link Down          | Link Down         |                                                                                                                                                                                                                     |

### Display the Status of Gigabit Ethernet Interfaces

**Purpose** To display the status of Gigabit Ethernet interfaces, use the following Junos OS command-line interface (CLI) operational mode command:

#### Sample Output Action

```
user@host> show interfaces terse ge*
Interface      Admin Link Proto Local          Remote
ge-2/2/0       down down
ge-2/2/0.0     up   down inet  65.113.23.105/30
ge-2/3/0       up   up
ge-2/3/0.0     up   up   inet  65.115.56.57/30
ge-3/1/0       up   up
ge-3/1/0.0     up   up   inet  65.115.56.193/30
ge-3/2/0       up   down
```

**Meaning** This sample output lists only the Gigabit Ethernet interfaces. It shows the status of both the physical and logical interfaces. See [Table 69 on page 779](#) for a description of what the output means.

Table 69: Status of Gigabit Ethernet Interfaces

| Physical Interface | Logical Interface | Status Description                                                                                                                    |
|--------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| ge-2/2/0           | ge-2/2/0.0        | This interface is administratively disabled ( <b>Admin Down</b> ). Both the physical and logical links are down ( <b>Link Down</b> ). |
| Admin Down         | Admin Up          |                                                                                                                                       |
| Link Down          | Link Down         |                                                                                                                                       |

Table 69: Status of Gigabit Ethernet Interfaces (*continued*)

| Physical Interface | Logical Interface | Status Description                                                        |
|--------------------|-------------------|---------------------------------------------------------------------------|
| <b>ge-2/3/0</b>    | <b>ge-2/3/0.0</b> | This interface has both the physical and logical links up and running.    |
| <b>Admin Up</b>    | <b>Admin Up</b>   |                                                                           |
| <b>Link Up</b>     | <b>Link Up</b>    |                                                                           |
| <b>ge-3/2/0</b>    | <b>ge-3/2/0.0</b> | This interface has both the physical link and the logical interface down. |
| <b>Admin Up</b>    | <b>Admin Up</b>   |                                                                           |
| <b>Link Down</b>   | <b>Link Down</b>  |                                                                           |

### Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface

**Purpose** To display the status of a specific Fast Ethernet or Gigabit Ethernet interface when you need to investigate its status further, use the following Junos OS CLI operational mode command:

**Action** `user@host> show interfaces (fe-fpc/pic/port | ge-fpc/pic/port)`

#### Sample Output 1

The following sample output is for a Fast Ethernet interface with the physical link up:

```
user@host> show interfaces fe-2/1/0
Physical interface: fe-2/1/0, Enabled, Physical link is Up
  Interface index: 31, SNMP ifIndex: 35
  Description: customer connection
  Link-level type: Ethernet, MTU: 1514, Source filtering: Disabled
  Speed: 100mbps, Loopback: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link flags     : None
  Current address: 00:90:69:86:71:1b, Hardware address: 00:90:69:86:71:1b
  Input rate     : 25768 bps (11 pps), Output rate: 1576 bps (3 pps)
  Active alarms  : None
  Active defects : None
  Logical interface fe-2/1/0.0 (Index 2) (SNMP ifIndex 43)
    Flags: SNMP-Traps, Encapsulation: ENET2
    Protocol inet, MTU: 1500, Flags: Is-Primary
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.116.151.218/29, Local: 10.119.115.217
      Broadcast: 10.116.151.225
```

#### Sample Output 2

The following output is for a Gigabit Ethernet interface with the physical link up:

```
user@host> show interfaces ge-3/1/0
Physical interface: ge-3/1/0, Enabled, Physical link is Up
  Interface index: 41, SNMP ifIndex: 55
  Description: customer connection
  Link-level type: Ethernet, MTU: 1514, Source filtering: Disabled
```



```

Speed: 1000mbps, Loopback: Disabled, Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps
Link flags : None
Current address: 00:90:69:85:71:99, Hardware address: 00:90:69:85:71:99
Input rate : 7412216 bps (1614 pps), Output rate: 2431184 bps (1776 pps)
Active alarms : None
Active defects : None
Logical interface ge-3/1/0.0 (Index 11) (SNMP ifIndex 57)
  Flags: SNMP-Traps, Encapsulation: ENET2
  Protocol inet, MTU: 1500
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.117.65.192/30, Local: 10.115.65.193
      Broadcast: 10.115.65.195

```

**Meaning** The first line of sample output 1 and 2 shows that the physical link is up. This means that the physical link is healthy and can pass packets. Further down the sample output, look for active alarms and defects. If you see active alarms or defects, to further diagnose the problem, see Step 3, “[Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface](#)” on page 781, to display more extensive information about the Fast Ethernet interface and the physical interface that is down.

### Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface

**Purpose** To display extensive status information about a specific Fast Ethernet or Gigabit Ethernet interface, use the following Junos OS CLI operational mode command:

**Action** `user@host> show interfaces (fe-fpc/pic/port | ge-fpc/pic/port) extensive`

#### Sample Output

The following sample output is for a Fast Ethernet interface:

```

user@router> show interfaces fe-1/3/3 extensive
Physical interface: fe-1/3/3, Enabled, Physical link is Up
  Interface index: 47, SNMP ifIndex: 38
  Description: Test
  Link-level type: Ethernet, MTU: 1514, Source filtering: Disabled
  Speed: 100mbps, Loopback: Disabled, Flow control: Enabled
  Device flags : Present Running
  Interface flags: SNMP-Traps
  Link flags : None
  Current address: 00:90:69:8d:2c:de, Hardware address: 00:90:69:8d:2c:de
  Statistics last cleared: 2002-01-11 23:03:09 UTC (1w2d 23:54 ago)
  Traffic statistics:
    Input bytes :          373012658          0 bps
    Output bytes :          153026154        1392 bps
    Input packets:          1362858          0 pps
    Output packets:          1642918          3 pps
  Input errors:
    Errors: 0 , Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 503660
    L3 incompletes: 1 , L2 channel errors: 0 , L2 mismatch timeouts: 0
    FIFO errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Collisions: 0, Drops: 0, Aged packets: 0
    HS link CRC errors: 0, FIFO errors: 0
  Active alarms : None

```

```

Active defects : None
MAC statistics:
  Total octets          439703575      Transmit 177452093
  Total packets        1866532        Transmit 1642916
  Unicast packets      972137         Transmit 1602563
  Broadcast packets    30             Transmit 2980
  Multicast packets    894365         Transmit 37373
  CRC/Align errors     0             Transmit 0
  FIFO errors          0             Transmit 0
  MAC control frames   0             Transmit 0
  MAC pause frames     0             Transmit 0
  Oversized frames     0
  Jabber frames        0
  Fragment frames      0
  VLAN tagged frames   0
  Code violations      0
Filter statistics:
  Input packet count    1866532
  Input packet rejects  0
  Input DA rejects      503674
  Input SA rejects      0
  Output packet count   1642916
  Output packet pad count 0
  Output packet error count 0
  CAM destination filters: 5, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Complete, Link partner status: OK
  Link partner: Full-duplex, Flow control: None
PFE configuration:
  Destination slot: 1, Stream number: 15
  CoS transmit queue bandwidth:
    Queue0: 95, Queue1: 0, Queue2: 0, Queue3: 5
  CoS weighted round-robin:
    Queue0: 95, Queue1: 0, Queue2: 0, Queue3: 5
Logical interface fe-1/3/3.0 (Index 8) (SNMP ifIndex 69)
  Description: Test
  Flags: SNMP-Traps, Encapsulation: ENET2
  Protocol inet, MTU: 1500, Flags: None
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 10.115.107.192/29, Local: 10.115.107.193
    Broadcast: 10.115.107.199

```

**Meaning** The sample output shows where the errors might be occurring and includes autonegotiation information. See [Table 70 on page 782](#) for a description of errors to look for.

**Table 70: Errors to Look For**

| Error                    | Meaning                                                                                                                                                                   |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Policed discards</b>  | Discarded frames that were not recognized or were not of interest.                                                                                                        |
| <b>L2 channel errors</b> | Packets for which the router could not find a valid logical interface. For example, the packet is for a virtual LAN (VLAN) that is not configured on the interface.       |
| <b>MTU</b>               | The maximum transmission unit (MTU) must match the interface of either the router at the remote end of the Fast Ethernet or Gigabit Ethernet link, or that of the switch. |

Table 70: Errors to Look For (*continued*)

| Error            | Meaning                                                                                                                                                  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input DA rejects | Number of packets with a destination Media Access Control (MAC) address that is not on the accept list. It is normal to see this number increment.       |
| Input SA rejects | Number of packets with a source MAC address that is not on the accept list. This number only increments when source MAC address filtering is configured. |

If the physical link is down, look at the active alarms and defects for the Fast Ethernet or Gigabit Ethernet interface and diagnose the Fast Ethernet or Gigabit Ethernet media accordingly. See “[Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters](#)” on page 800 for an explanation of Fast Ethernet and Gigabit Ethernet alarms.

[Table 71 on page 783](#) lists and describes some MAC statistics errors to look for.

Table 71: MAC Statistics Errors

| Error              | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CRC/Align errors   | The total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had either a bad FCS with an integral number of octets ( <b>FCS Error</b> ) or a bad FCS with a non-integral number of octets ( <b>Alignment Error</b> ).                                                                                                                                                                       |
| MAC control frames | The number of MAC control frames.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| MAC pause frames   | The number of MAC control frames with <b>pause</b> operational code.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Jabber frames      | <p>The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error.</p> <p>Note that this definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition where any packet exceeds 20 ms. The allowed range to detect jabber is between 20 ms and 150 ms.</p> |
| Fragment frames    | <p>The total number of packets received that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error an alignment error.</p> <p>Note that it is entirely normal for fragment frames to increment because both runts (which are normal occurrences due to collisions) and noise hits are counted.</p>                                                                                                                         |

Autonegotiation is the process that connected Ethernet interfaces use to communicate the information necessary to interoperate. [Table 72 on page 783](#) explains the autonegotiation information of the **show interface *interface-name* extensive** command output.

Table 72: Autonegotiation Information

| Autonegotiation Field Information | Explanation                                                                                                                    |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Negotiation status: Incomplete    | The <b>Negotiation status</b> field shows <b>Incomplete</b> when the Ethernet interface has the speed or link mode configured. |

Table 72: Autonegotiation Information (*continued*)

| Autonegotiation Field Information                       | Explanation                                                                                                                                                                                                                                            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Negotiation status: No autonegotiation                  | The <b>Negotiation status</b> field shows <b>No autonegotiation</b> when the remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.                                                                     |
| Negotiation status: Complete<br>Link partner status: OK | The <b>Negotiation status</b> field shows <b>Complete</b> and the <b>Link partner</b> field shows <b>OK</b> when the Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process completes successfully. |
| Link partner: Half-duplex                               | The <b>Link partner</b> field can be <b>Full-duplex</b> or <b>Half-duplex</b> depending on the capability of the attached Ethernet device.                                                                                                             |
| Flow control: Symmetric/asymmetric                      | The <b>Flow control</b> field displays the types of flow control supported by the remote Ethernet device.                                                                                                                                              |

### Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface

**Purpose** To monitor statistics for a Fast Ethernet or Gigabit Ethernet interface, use the following Junos OS CLI operational mode command:

**Action** `user@host> monitor interface (fe-fpc/pic/port | ge-fpc/pic/port)`



**CAUTION:** We recommend that you use the monitor interface `fe-fpc/pic/port` or monitor interface `ge-fpc/pic/port` command only for diagnostic purposes. Do not leave these commands on during normal router operations because real-time monitoring of traffic consumes additional CPU and memory resources.

### Sample Output

The following sample output is for a Fast Ethernet interface:

```

user@host> monitor interface fe-2/1/0
Interface: fe-2/1/0, Enabled, Link is Up
Encapsulation: Ethernet, Speed: 100mbps
Traffic statistics:
Input bytes:          282556864218 (14208 bps)      Current Delta [40815]
Output bytes:         42320313078 (384 bps)         [890]
Input packets:        739373897 (11 pps)           [145]
Output packets:       124798688 (1 pps)            [14]
Error statistics:
Input errors:          0                           [0]
Input drops:           0                           [0]
Input framing errors:  0                           [0]
Policed discards:      6625892                      [6]
L3 incompletes:        75                          [0]
L2 channel errors:     0                           [0]
L2 mismatch timeouts: 0                           [0]
Carrier transitions:   1                           [0]
Output errors:         0                           [0]

```

```

Output drops:                                0                [0]
Aged packets:                                0                [0]
Active alarms : None
Active defects: None
Input MAC/Filter statistics:
Unicast packets                            464751787            [154]
Packet error count                          0                  [0]

```

**Meaning** Use the information from this command to help narrow down possible causes of an interface problem.



**NOTE:** If you are accessing the router from the console connection, make sure you set the CLI terminal type using the `set cli terminal` command.

The statistics in the second column are the cumulative statistics since the last time they were cleared using the `clear interfaces statistics interface-name` command. The statistics in the third column are the cumulative statistics since the `monitor interface interface-name` command was executed.

If the input errors are increasing, verify the following:

1. Check the cabling to the router and have the carrier verify the integrity of the line. To verify the integrity of the cabling, make sure that you have the correct cables for the interface port. Make sure you have single-mode fiber cable for a single-mode interface and multimode fiber cable for a multimode interface.
2. For a fiber-optic connection, measure the received light level at the receiver end and make sure that it is within the receiver specification of the Ethernet interface. See [“Fiber-Optic Ethernet Interface Specifications” on page 785](#) for the fiber-optic Ethernet interface specifications.
3. Measure the transmit light level on the Tx port to verify that it is within specification. See [“Fiber-Optic Ethernet Interface Specifications” on page 785](#) for the optical specifications.

## Fiber-Optic Ethernet Interface Specifications

Table 73 on page 785 shows the specifications for fiber-optic interfaces for Juniper Networks routers.

**Table 73: Fiber-Optic Ethernet Interface Specifications**

| Fiber-Optic Ethernet Interface | Length                                      | Wavelength      | Average Launch Power | Receiver Saturation | Receiver Sensitivity                     |
|--------------------------------|---------------------------------------------|-----------------|----------------------|---------------------|------------------------------------------|
| <b>Gigabit Ethernet</b>        |                                             |                 |                      |                     |                                          |
| <b>Duplex SC connector</b>     |                                             |                 |                      |                     |                                          |
| <b>LH optical interface</b>    | 49.5-mile 70-km reach on 8.2-micrometer SMF | 1480 to 1580 nm | -3 to +2 dBm         | -3 dBm              | -23 dBm (BER 10 <sup>-12</sup> ) for SMF |

Table 73: Fiber-Optic Ethernet Interface Specifications (*continued*)

| Fiber-Optic Ethernet Interface                   | Length                                                                                                           | Wavelength      | Average Launch Power | Receiver Saturation | Receiver Sensitivity |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|---------------------|----------------------|
| <b>LX optical interface</b>                      | 6.2-mile 10-km reach on 9/125-micrometer SMF<br><br>1804.5-ft 550-m reach on 62.5/125- and 50/125-micrometer MMF | 1270 to 1355 nm | -11 to -3 dBm        | -3 dBm              | -19 dBm              |
| <b>SX optical interface</b>                      | 656-ft 200-m reach on 62.5/125-micrometer MMF<br><br>1640-ft 500-m reach on 50/125-micrometer MMF                | 830 to 860 nm   | -9.5 to -4 dBm       | -3 dBm              | -17 dBm              |
| <b>Fast Ethernet 8-Port</b>                      |                                                                                                                  |                 |                      |                     |                      |
| <b>FX optical interface with MT-RJ connector</b> | 1.24-mile 2-km reach on 62.5/125-micrometer MMF                                                                  | 1270 to 1380 nm | -20 to -14 dBm       | -14 dBm             | -34 dBm              |

## Performing Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces

- [Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces on page 786](#)
- [Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface on page 787](#)
- [Create a Loopback on page 788](#)
- [Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 790](#)
- [Configure a Static Address Resolution Protocol Table Entry on page 793](#)
- [Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 797](#)
- [Ping the Fast Ethernet or Gigabit Ethernet Interface on page 797](#)
- [Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 798](#)
- [Diagnose a Suspected Circuit Problem on page 800](#)

## Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces

**Purpose** To use loopback testing to isolate Fast Ethernet and Gigabit Ethernet interface problems.

**Action** [Table 74 on page 787](#) provides links and commands for using loopback testing for Fast Ethernet and Gigabit Ethernet interfaces.

Table 74: Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces

| Tasks                                                                                                         | Command or Action                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>“Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface” on page 787</b> |                                                                                                                                                                                                                                                   |
| 1. <a href="#">Create a Loopback on page 788</a>                                                              |                                                                                                                                                                                                                                                   |
| a. <a href="#">Create a Physical Loopback for a Fiber-Optic Interface on page 788</a>                         | Connect the transmit port to the receive port.                                                                                                                                                                                                    |
| b. <a href="#">Create a Loopback Plug for an RJ-45 Ethernet Interface on page 788</a>                         | Cross pin 1 (TX+) and pin 3 (RX+) together, and pin 2 (TX-) and pin 6 (RX-) together.                                                                                                                                                             |
| c. <a href="#">Configure a Local Loopback on page 789</a>                                                     | <pre>[edit interfaces <i>interface-name</i> (fastether-options   gigether-options)] set loopback show commit</pre>                                                                                                                                |
| 2. <a href="#">Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 790</a>              | <pre>show interfaces (fe-<i>fpc/pic/port</i>   ge-<i>fpc/pic/port</i>)</pre>                                                                                                                                                                      |
| 3. <a href="#">Configure a Static Address Resolution Protocol Table Entry on page 793</a>                     | <pre>show interfaces ge-<i>fpc/pic/port</i> [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet address <i>address</i>] set arp <i>ip-address</i> mac <i>mac-address</i> show commit run show arp no-resolve</pre> |
| 4. <a href="#">Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 797</a>                   | <pre>clear interfaces statistics fe-<i>fpc/pic/port</i>   ge-<i>fpc/pic/port</i></pre>                                                                                                                                                            |
| 5. <a href="#">Ping the Fast Ethernet or Gigabit Ethernet Interface on page 797</a>                           | <pre>ping <i>remote-IP-address</i> bypass-routing interface (fe-<i>fpc/pic/port</i>   ge-<i>fpc/pic/port</i> count 100 rapid</pre>                                                                                                                |
| 6. <a href="#">Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 798</a>         | <pre>show interfaces (fe-<i>fpc/pic/port</i>   ge-<i>fpc/pic/port</i> ) extensive</pre>                                                                                                                                                           |
| <b>“Diagnose a Suspected Circuit Problem” on page 800</b>                                                     | Perform Steps 2 through 8 from “Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface” on page 787.                                                                                                            |

## Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface

**Problem**    **Description:** When you suspect a hardware problem, take the following steps to help verify if there is a problem.

**Solution**    To diagnose a suspected hardware problem with the Ethernet interface, follow these steps:

- [Create a Loopback on page 788](#)
- [Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 790](#)
- [Configure a Static Address Resolution Protocol Table Entry on page 793](#)
- [Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 797](#)
- [Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 798](#)

## Create a Loopback

You can create a physical loopback or configure a local loopback to help diagnose a suspected hardware problem. Creating a physical loopback is recommended because it allows you to test and verify the transmit and receive ports. If a field engineer is not available to create the physical loopback, you can configure a local loopback for the interface. The local loopback creates a loopback internally in the Physical Interface Card (PIC).

1. [Create a Physical Loopback for a Fiber-Optic Interface on page 788](#)
2. [Create a Loopback Plug for an RJ-45 Ethernet Interface on page 788](#)
3. [Configure a Local Loopback on page 789](#)

---

### Create a Physical Loopback for a Fiber-Optic Interface

#### Action

To create a physical loopback at the port, connect the transmit port to the receive port using a known good fiber cable.



**NOTE:** Make sure you use single-mode fiber for a single-mode port and multimode fiber for a multimode port.

#### Meaning

When you create and then test a physical loopback, you are testing the transmit and receive ports of the PIC. This action is recommended if a field engineer is available to create the physical loop as it provides a more complete test of the PIC.

---

### Create a Loopback Plug for an RJ-45 Ethernet Interface

#### Action

To create a loopback plug, cross pin 1 (TX+) and pin 3 (RX+) together, and cross pin 2 (TX-) and pin 6 (RX-) together. You need the following equipment to create the loopback:

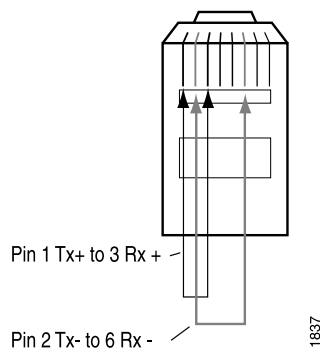
- A 6-inch long CAT5 cable
- An RJ-45 connector
- A crimping tool



Figure 52 on page 789 illustrates how to create a loopback plug for an RJ-45 Ethernet interface.

**Figure 52: RJ-45 Ethernet Loopback Plug**

**RJ-45 Ethernet Loopback Plug**



### Meaning

When you create and then test a physical loopback, you are testing the RJ-45 interface of the PIC. This action is recommended if a field engineer is available to create the physical loop as it provides a more complete test of the PIC.

### Configure a Local Loopback

#### Action

To configure a local loopback without physically connecting the transmit port to the receive port, follow these steps:

1. In configuration mode, go to the following hierarchy level:  

```
[edit]
user@host# edit interfaces interface-name (fastether-options | gigether-options)
```
2. Configure the local loopback:  

```
[edit interfaces interface-name (fastether-options | gigether-options)]
user@host# set loopback
```
3. Verify the configuration:  

```
user@host# show
```

For example:

```
[edit interfaces fe-1/0/0 fastether-options]
user@host# show
loopback;
```
4. Commit the change:  

```
user@host# commit
```

For example:

```
[edit interfaces fe-1/0/0 fastether-options]
user@host# commit
```

commit complete

When you create a local loopback, you create an internal loop on the interface being tested. A local loopback loops the traffic internally on that PIC. A local loopback tests the interconnection of the PIC but does not test the transmit and receive ports. On an Ethernet interface, you cannot create a remote loopback, therefore there is no option to use a **local** or **remote** statement. Simply including the **loopback** statement at the **[edit interfaces interface-name (fastether-options | gether-options)]** hierarchy level, places the interface into local loopback mode.



**NOTE:** Remember to delete the loopback statement after completing the test.

## Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up

**Purpose** Display the status of the Fast Ethernet or Gigabit Ethernet interface to provide the information you need to determine whether the physical link is up or down.

**Action** To verify that the status of the Fast Ethernet or Gigabit Ethernet interface is up, use the following Junos OS command-line interface (CLI) operational mode command:

```
user@host> show interfaces (fe-fpc/port | ge-fpc/pic/port)
```

### Sample Output

```
user@host# show interfaces ge-4/0/6 extensive
Physical interface: ge-4/0/6, Enabled, Physical link is Up
  Interface index: 144, SNMP ifIndex: 516, Generation: 147
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, BPDU Error: None,
  MAC-REWRITE Error: None, Loopback: Enabled, Source filtering: Disabled,
  Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running Loop-Detected
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues    : 8 supported, 4 maximum usable queues
  Schedulers    : 0
  Hold-times    : Up 0 ms, Down 0 ms
  Current address: 00:1f:12:fe:c5:2e, Hardware address: 00:1f:12:fe:c5:2e
  Last flapped  : 2015-01-20 23:40:04 PST (00:02:12 ago)
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes  : 0                      0 bps
    Output bytes : 0                      0 bps
    Input packets: 0                      0 pps
    Output packets: 0                    0 pps
  IPv6 transit statistics:
    Input bytes  : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
  Dropped traffic statistics due to STP State:
    Input bytes  : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
```

```

Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors:
0,
  Resource errors: 0
Output errors:
  Carrier transitions: 1, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort      0              0              0
  1 expedited-fo     0              0              0
  2 assured-forw     0              0              0
  3 network-cont     0              0              0

Queue number:      Mapped forwarding classes
  0                best-effort
  1                expedited-forwarding
  2                assured-forwarding
  3                network-control

Active alarms : None
Active defects : None
MAC statistics:
Total octets      Receive      Transmit
Total packets    0            0
Unicast packets  0            0
Broadcast packets 0            0
Multicast packets 0            0
CRC/Align errors 0            0
FIFO errors       0            0
MAC control frames 0            0
MAC pause frames  0            0
Oversized frames  0
Jabber frames     0
Fragment frames   0
VLAN tagged frames 0
Code violations   0
Filter statistics:
Input packet count      0
Input packet rejects    0
Input DA rejects        0
Input SA rejects        0
Output packet count      0
Output packet pad count  0
Output packet error count 0
CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
Negotiation status: Complete
Link partner:
  Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault:
OK
Local resolution:
  Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
  Destination slot: 4
CoS information:

```

```

Direction : Output
CoS transmit queue          Bandwidth          Buffer Priority
Limit
                                %          bps          %          usec
0 best-effort              95      950000000    95          0      low
none
3 network-control          5       50000000     5          0      low
none
Interface transmit statistics: Disabled

```

### Meaning

The sample output shows that the link is up and there are no alarms in this loopback configuration. When an internal loopback is configured, the physical loopback should come up without an alarm.

### Sample Output

When you see that the physical link is down, there may be a problem with the port. The following output is an example of the `show interfaces fe-fpc/pic/port` command when the physical link is down:

```

user@router> show interfaces fe-1/3/0
Physical interface: fe-1/3/0, Enabled, Physical link is Down
Interface index: 44, SNMP ifIndex: 35
Link-level type: Ethernet, MTU: 1514, Source filtering: Disabled
Speed: 100mbps, Loopback: Disabled, Flow control: Enabled
Device flags   : Present Running Down
Interface flags: Hardware-Down SNMP-Traps
Link flags     : None
Current address: 00:90:69:8d:2c:db, Hardware address: 00:90:69:8d:2c:db
Input rate     : 0 bps (0 pps), Output rate: 0 bps (0 pps)
Active alarms : LINK
Active defects: LINK
MAC statistics:
  Input octets: 0, Input packets: 0, Output octets: 0, Output packets: 0
Filter statistics:
  Filtered packets: 0, Padded packets: 0, Output packet errors: 0
Autonegotiation information:
  Negotiation status: Incomplete, Link partner status: Down
  Reason: Link partner autonegotiation failure
  Link partner: Half-duplex, Flow control: None

```

**Meaning** The sample output shows that the physical link is down and there are active alarms and defects.

[Table 75 on page 792](#) presents problem situations and actions for a physical link that is down.

**Table 75: Problems and Solutions for a Physical Link That Is Down**

| Problem                    | Action                                                                          |
|----------------------------|---------------------------------------------------------------------------------|
| Cable mismatch             | Verify that the fiber connection is correct.                                    |
| Damaged and/or dirty cable | Verify that the fiber can successfully loop a known good port of the same type. |

**Table 75: Problems and Solutions for a Physical Link That Is Down**  
(continued)

| Problem                                                                                   | Action                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Too much or too little optical attenuation                                                | Verify that the attenuation is correct per the PIC optical specifications.                                                                                                                                                                                                    |
| The transmit port is not transmitting within the dBm optical range per the specifications | Verify that the Tx power of the optics is within range of the PIC optical specification.                                                                                                                                                                                      |
| Mismatch between the cable type and the port                                              | Verify that a single-mode fiber cable is connected to a single-mode interface and that a multimode fiber cable is connected to a multimode interface. (This problem does not always cause the physical link to go down; errors and dropped packets are sometimes the result.) |

## Configure a Static Address Resolution Protocol Table Entry

### Purpose

Configure a static Address Resolution Protocol (ARP) entry to allow a packet to be sent out of a looped Ethernet interface.



**NOTE:** Remove the static ARP entry at the end of the loop test after you have completed the tests and monitored interface traffic.

### Action

To configure a static ARP table entry for a Gigabit Ethernet interface, follow these steps. You can follow the same procedure to configure a static ARP entry for a Fast Ethernet interface.

1. Find the Media Access Control (MAC) address for the Gigabit Ethernet interface:

```
user@host> show interfaces ge-fpc/pic/port
```

```
Physical interface: ge-4/0/6, Enabled, Physical link is Up
  Interface index: 144, SNMP ifIndex: 516, Generation: 147
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, BPDU Error: None,
  MAC-REWRITE Error: None, Loopback: Enabled, Source filtering: Disabled,
  Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running Loop-Detected
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 4 maximum usable queues
  Schedulers     : 0
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1f:12:fe:c5:2e, Hardware address: 00:1f:12:fe:c5:2e
  Last flapped   : 2015-01-20 23:40:04 PST (00:13:49 ago)
  Statistics last cleared: 2015-01-20 23:46:15 PST (00:07:38 ago)
  Traffic statistics:
    Input bytes   :          125500          0 bps
    Output bytes  :          125482          0 bps
```

```

Input packets:          1281          0 pps
Output packets:         1281          0 pps
IPv6 transit statistics:
  Input bytes :          0
  Output bytes :          0
  Input packets:         0
  Output packets:        0
Dropped traffic statistics due to STP State:
  Input bytes :          0
  Output bytes :          0
  Input packets:         0
  Output packets:        0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO
errors: 0,
  Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets:
0,
  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets    Dropped packets

  0 best-effort          1260          1260
0
  1 expedited-fo          0          0
0
  2 assured-forw          0          0
0
  3 network-cont          0          0
0
Queue number:      Mapped forwarding classes
  0                best-effort
  1                expedited-forwarding
  2                assured-forwarding
  3                network-control
Active alarms : None
Active defects : None
MAC statistics:
Total octets          130624          130624
Total packets          1281          1281
Unicast packets        1280          1280
Broadcast packets      1          1
Multicast packets      0          0
CRC/Align errors       0          0
FIFO errors            0          0
MAC control frames     0          0
MAC pause frames       0          0
Oversized frames       0
Jabber frames          0
Fragment frames        0
VLAN tagged frames     0
Code violations        0
Filter statistics:
Input packet count      1281
Input packet rejects    0
Input DA rejects        0
Input SA rejects        0
Output packet count      1281
Output packet pad count  0

```

```

Output packet error count                                0
CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
Negotiation status: Complete
Link partner:
Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote
fault: OK
Local resolution:
Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
Destination slot: 4
CoS information:
Direction : Output
CoS transmit queue      Bandwidth      Buffer Priority
Limit
                                %      bps      %      usec
0 best-effort            95      950000000  95      0      low
none
3 network-control        5      500000000   5      0      low
none
Interface transmit statistics: Disabled

Logical interface ge-4/0/6.0 (Index 72) (SNMP ifIndex 573) (Generation 137)

Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2
Traffic statistics:
Input bytes :      125500
Output bytes :      123480
Input packets:      1281
Output packets:      1260
Local statistics:
Input bytes :      60
Output bytes :      2002
Input packets:      1
Output packets:      21
Transit statistics:
Input bytes :      0      0 bps
Output bytes :      0      0 bps
Input packets:      0      0 pps
Output packets:      0      0 pps
Security: Zone: HOST
Allowed host-inbound traffic : any-service bfd bgp dvmrp igmp ldp msdp
nhrp ospf pgm
pim rip router-discovery rsvp sap vrrp
Flow Statistics :
Flow Input statistics :
Self packets :      0
ICMP packets :      40
VPN packets :      0
Multicast packets :      0
Bytes permitted by policy :      107520
Connections established :      20
Flow Output statistics:
Multicast packets :      0
Bytes permitted by policy :      107520
Flow error statistics (Packets dropped due to):
Address spoofing:      0
Authentication failed:      0
Incoming NAT errors:      0
Invalid zone received packet:      0
Multiple user authentications:      0

```

```

Multiple incoming NAT:          0
No parent for a gate:          0
No one interested in self packets: 0
No minor session:              0
No more sessions:              0
No NAT gate:                   0
No route present:              11
No SA for incoming SPI:        0
No tunnel found:               0
No session for a gate:         0
No zone or NULL zone binding   0
Policy denied:                 0
Security association not active: 0
TCP sequence number out of window: 0
Syn-attack protection:         0
User authentication errors:     0
Protocol inet, MTU: 1500, Generation: 158, Route table: 0
Flags: Sendbroadcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.108.120.0/30, Local: 10.108.120.1, Broadcast:
10.108.120.3,
Generation: 158
Protocol multiservice, MTU: Unlimited, Generation: 159, Route table: 0
Policer: Input: __default_arp_policer__

```

2. In configuration mode, go to the following hierarchy level:

```
[edit]
```

```
user@host# edit interfaces interface-name unit logical-unit-number family inet address
address
```

3. Configure the static ARP entry:

```
user@host# set arp ip-address mac mac-address
```

4. Commit the configuration:

```
user@host# commit
```

5. Verify that the static ARP entry is installed:

```
[edit interfaces ge-4/0/6 unit 0 family inet address 10.108.120.1/30]
user@host# run show arp no-resolve
```

| MAC Address       | Address       | Interface  | Flags     |
|-------------------|---------------|------------|-----------|
| 00:1f:12:fe:c5:2e | 10.108.120.2  | ge-4/0/6.0 | permanent |
| 52:54:00:7d:33:4c | 10.204.128.35 | fxp0.0     | none      |
| 52:54:00:65:11:50 | 10.204.128.36 | fxp0.0     | none      |
| 52:54:00:da:30:82 | 10.204.128.37 | fxp0.0     | none      |
| 52:54:00:3a:cf:4b | 10.204.128.38 | fxp0.0     | none      |
| 52:54:00:de:88:5f | 10.204.128.45 | fxp0.0     | none      |
| 52:54:00:48:03:b7 | 10.204.128.46 | fxp0.0     | none      |

## Meaning

The sample output is for Step 1 through Step 6 and shows that a static ARP entry was configured on Gigabit Ethernet interface **ge-4/0/6**.



## Clear Fast Ethernet or Gigabit Ethernet Interface Statistics

### Purpose

You can reset the Fast Ethernet and Gigabit Ethernet interface statistics. Resetting the statistics provides a clean start so that previous input/output errors and packet statistics do not interfere with the current diagnostics.

### Action

To clear all statistics for the interface, use the following Junos OS CLI operational mode command:

```
user@host> clear interfaces statistics (fe-fpc/pic/port | ge-fpc/pic/port)
```

### Sample Output

```
user@host> clear interfaces statistics ge-4/0/6
user@host>
```

### Meaning

This command clears the interface statistics counters for the Gigabit Ethernet interface only.

## Ping the Fast Ethernet or Gigabit Ethernet Interface

**Purpose** Use the ping command to verify the loopback connection.

**Action** To send ping packets from the Ethernet interface, use the following Junos OS CLI operational mode command:

```
user@host> ping remote-IP-address bypass-routing interface (fe-fpc/pic/port |
ge-fpc/pic/port) count 100 rapid
```

### Sample Output

```
user@router> ping 10.108.120.2 bypass-routing interface ge-7/2/1 count 100 rapid
PING 10.108.120.2 (10.108.120.2): 56 data bytes
36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e871 0 0000 01 01 cc5c 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e874 0 0000 01 01 cc59 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e878 0 0000 01 01 cc55 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e87c 0 0000 01 01 cc51 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e880 0 0000 01 01 cc4d 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
Vr HL TOS Len ID Flg off TTL Pro cks Src Dst
 4 5 00 0054 e884 0 0000 01 01 cc49 10.108.120.1 10.108.120.2
.36 bytes from 10.108.120.1: Time to live exceeded
```

**Meaning** The sample output shows that the time to live (TTL) expired, indicating that the link is receiving the frames from the ping test. The MAC address used is the same as the physical address of the port being tested because this allows the port to accept the frames from the ping test. As the packet is looped over the link, you expect to receive a TTL exceeded message for each ping sent. These messages are generated because the ping packets are repeatedly looped between the router and the physical loopback. When the packet is sent to the other end of the link, which does not exist, the loopback returns the packet back to the same interface, where it is again subjected to the Packet Forwarding Engine fabric for routing. After the route lookup, the TTL is decremented, and the packet is again sent out of the looped interface. This process repeats until the packet is either lost, or the TTL expires with subsequent TTL expired message displayed. Should any errors occur, the packet is discarded and a time-out error is displayed, rather than the expected TTL expired message. Note that the default TTL for ICMP echo packets in Junos OS is 64. This means a given test packet must be successfully sent and received 63 times before a TTL expired message can be generated. You can alter the TTL value to adjust the tolerance for loss, for example, a value of 255 is the most demanding test because now the packet must be sent and received error free 254 times.

## Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics

**Purpose** Persistent interface error statistics indicate that you need to open a case with the Juniper Networks Technical Assistance Center (JTAC).

**Action** To check the local interface for error statistics, use the following Junos OS CLI operational mode command:

```
user@host> show interfaces (fe-fpc/pic/port | ge-fpc/pic/port) extensive
```

### Sample Output

```
user@router> show interfaces ge-4/0/6 extensive
Physical interface: ge-4/0/6, Enabled, Physical link is Up   Interface index: 144, SNMP
ifIndex: 516, Generation: 147
Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Enabled, Source filtering: Disabled,
Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online
Device flags   : Present Running Loop-Detected
Interface flags: SNMP-Traps Internal: 0x4000
Link flags     : None
CoS queues    : 8 supported, 4 maximum usable queues
Schedulers    : 0
Hold-times    : Up 0 ms, Down 0 ms
Current address: 00:1f:12:fe:c5:2e, Hardware address: 00:1f:12:fe:c5:2e
Last flapped   : 2015-01-20 23:40:04 PST (00:02:12 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes   : 0                      0 bps
Output bytes  : 0                      0 bps
Input packets : 0                      0 pps
Output packets: 0                      0 pps
IPv6 transit statistics:
Input bytes   : 0
Output bytes  : 0
Input packets : 0
Output packets: 0
```

```

Dropped traffic statistics due to STP State:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors:
0,
  Resource errors: 0
Output errors:
  Carrier transitions: 1, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort      0              0              0
  1 expedited-fo     0              0              0
  2 assured-forw     0              0              0
  3 network-cont     0              0              0

Queue number:      Mapped forwarding classes
  0                best-effort
  1                expedited-forwarding
  2                assured-forwarding
  3                network-control

Active alarms : None
Active defects : None
MAC statistics:
Total octets      Receive      Transmit
Total packets    0            0
Unicast packets  0            0
Broadcast packets 0            0
Multicast packets 0            0
CRC/Align errors 0            0
FIFO errors       0            0
MAC control frames 0            0
MAC pause frames  0            0
Oversized frames  0
Jabber frames     0
Fragment frames   0
VLAN tagged frames 0
Code violations   0
Filter statistics:
Input packet count      0
Input packet rejects    0
Input DA rejects        0
Input SA rejects        0
Output packet count      0
Output packet pad count  0
Output packet error count 0
CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
Negotiation status: Complete
Link partner:
  Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault:
OK

```

```
Local resolution:
  Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
  Destination slot: 4
CoS information:
  Direction : Output
  CoS transmit queue      Bandwidth      Buffer Priority
Limit                    %      bps      %      usec
0 best-effort            95      950000000  95      0      low
none
3 network-control        5      50000000   5      0      low
none
Interface transmit statistics: Disabled
```

**Meaning** Check for any error statistics. There should not be any input or output errors. If there are any persistent input or output errors, open a case with the Juniper Networks Technical Assistance Center (JTAC) at [support@juniper.net](mailto:support@juniper.net), or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

## Diagnose a Suspected Circuit Problem

**Purpose** When you suspect a circuit problem, it is important to work with the transport-layer engineer to resolve the problem. The transport-layer engineer may create a loop to the router from various points in the network. You can then perform tests to verify the connection from the router to that loopback in the network.

**Action** After the transport-layer engineer has created the loop to the router from the network, you must verify the connection from the router to the loopback in the network. Follow Step 2 through Step 8 in [“Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface” on page 787](#). Keep in mind that any problems encountered in the test indicate a problem with the connection from the router to the loopback in the network.

By performing tests to loopbacks at various points in the network, you can isolate the source of the problem.

## Locating the Fast Ethernet and Gigabit Ethernet LINK Alarm and Counters

---

- [Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters on page 800](#)
- [Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm on page 801](#)
- [Fast Ethernet and Gigabit Ethernet Counters on page 802](#)

## Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters

**Purpose** To locate LINK alarm and major counters associated with Fast Ethernet and Gigabit Ethernet interfaces.

**Action** [Table 76 on page 801](#) provides links and commands for locating LINK alarm and major counters for Fast Ethernet and Gigabit Ethernet interfaces.

**Table 76: Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters**

| Tasks                                                                                            | Command or Action                                                          |
|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <a href="#">“Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm” on page 801</a> | <code>show interfaces (fe-fpc/pic/port   ge-fpc/pic/port) extensive</code> |
| <a href="#">“Fast Ethernet and Gigabit Ethernet Counters” on page 802</a>                        |                                                                            |

## Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm

**Problem** **Description:** To display the Fast Ethernet or Gigabit Ethernet LINK alarm, use the following Junos OS command-line interface (CLI) operational mode command:

**Solution** `user@host> show interfaces (fe-fpc/pic/port | ge-fpc/pic/port) extensive`

### Sample Output

The following sample output is for a Fast Ethernet interface:

```
user@host> show interfaces fe-1/3/3 extensive
Physical interface: fe-1/3/3, Enabled, Physical link is Down
  Interface index: 47, SNMP ifIndex: 38
  Description: Test
  Link-level type: Ethernet, MTU: 1514, Source filtering: Disabled
  Speed: 100mbps, Loopback: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link flags     : None
  Current address: 00:90:69:8d:2c:de, Hardware address: 00:90:69:8d:2c:de
  Statistics last cleared: 2002-01-11 23:03:09 UTC (1w2d 23:54 ago)
  Traffic statistics:
    Input bytes   :           373012658                0 bps
    Output bytes  :           153026154             1392 bps
    Input packets :           1362858                0 pps
    Output packets:           1642918                3 pps
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 503660
    L3 incompletes: 1, L2 channel errors: 0, L2 mismatch timeouts: 0
    FIFO errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Collisions: 0, Drops: 0, Aged packets: 0
    HS link CRC errors: 0, FIFO errors: 0
  Active alarms : LINK
  Active defects : LINK
  MAC statistics:
    Total octets          Receive          Transmit
    Total packets         1866532          1642916
    Unicast packets       972137          1602563
    Broadcast packets      30             2980
    Multicast packets     894365          37373
    CRC/Align errors      0              0
    FIFO errors           0              0
```

```

MAC control frames          0          0
MAC pause frames           0          0
Oversized frames           0
Jabber frames              0
Fragment frames            0
VLAN tagged frames         0
Code violations             0
Filter statistics:
  Input packet count        1866532
  Input packet rejects      0
  Input DA rejects          503674
  Input SA rejects          0
  Output packet count       1642916
  Output packet pad count   0
  Output packet error count 0
  CAM destination filters: 5, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Complete, Link partner status: OK
  Link partner: Full-duplex, Flow control: None
PFE configuration:
  Destination slot: 1, Stream number: 15
  CoS transmit queue bandwidth:
    Queue0: 95, Queue1: 0, Queue2: 0, Queue3: 5
  CoS weighted round-robin:
    Queue0: 95, Queue1: 0, Queue2: 0, Queue3: 5
Logical interface fe-1/3/3.0 (Index 8) (SNMP ifIndex 69)
  Description: Test
  Flags: SNMP-Traps, Encapsulation: ENET2
  Protocol inet, MTU: 1500, Flags: None
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 10.115.107.192/29, Local: 10.115.107.193
    Broadcast: 10.115.107.199

```

### Meaning

The sample output shows where the alarm and other errors might be occurring and any counters that are incrementing. The only alarm associated with Fast Ethernet or Gigabit Ethernet interfaces is the LINK alarm. A LINK alarm indicates a physical problem. To isolate where the physical problem might be occurring, conduct loopback testing. See [“Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces”](#) on page 786 for information on conducting a loopback test.



**NOTE:** Since link status is polled once every second, some items that require fast link down detection, such as Multiprotocol Label Switching (MPLS) fast reroute, take longer to execute.

## Fast Ethernet and Gigabit Ethernet Counters

**Problem** **Description:** [Table 77 on page 803](#) shows the major counters that appear in the output for the **show interfaces fe-fpc/pic/port extensive** and the **show interfaces ge-fpc/pic/port extensive** commands. These counters generally increment when there is a problem with a Fast Ethernet or Gigabit Ethernet interface. In the **Counters** column, the counters are listed in the order in which they are displayed in the output.

Table 77: Major Fast Ethernet and Gigabit Ethernet Counters

| Counter                     | Description                                                                                                                            | Reason for Increment                                                                                                                                                                                                         |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Input Errors:</b>        |                                                                                                                                        |                                                                                                                                                                                                                              |
| <b>Errors</b>               | The sum of the incoming frame aborts and frame check sequence (FCS) errors.                                                            |                                                                                                                                                                                                                              |
| <b>Policed discards</b>     | The frames discarded by the incoming packet match code.                                                                                | The frames were discarded because they were not recognized or of interest. Usually, this field reports protocols that the Junos OS does not handle.                                                                          |
| <b>Drops</b>                | The number of packets dropped by the output queue of the I/O Manager application-specific integrated circuit (ASIC).                   | If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's random early detection (RED) mechanism.                                                                            |
| <b>L3 incompletes</b>       | The number of packets discarded due to the packets failing Layer 3 header checks.                                                      | This counter increments when the incoming packet fails Layer 3 (usually IPv4) checks of the header. For example, a frame with less than 20 bytes of available IP header would be discarded and this counter would increment. |
| <b>L2 channel errors</b>    | The errors that occur when the software could not find a valid logical interface (such as <b>fe-1/2/3.0</b> ) for an incoming frame.   | This error increments when, for example, a lookup for a virtual LAN (VLAN) fails.                                                                                                                                            |
| <b>L2 mismatch timeouts</b> | The count of malformed or short packets.                                                                                               | The malformed or short packets cause the incoming packet handler to discard the frame and be unreadable.                                                                                                                     |
| <b>FIFO errors</b>          | The number of first in, first out (FIFO) errors in the receive direction as reported by the ASIC on the Physical Interface Card (PIC). | The value in this field should always be 0. If this value is not zero, cabling could be badly organized or the PIC could be broken.                                                                                          |
| <b>Output Errors</b>        |                                                                                                                                        |                                                                                                                                                                                                                              |
| <b>Errors</b>               | The sum of outgoing frame aborts and FCS errors.                                                                                       |                                                                                                                                                                                                                              |
| <b>Collisions</b>           | The number of Ethernet collisions.                                                                                                     | The Fast Ethernet PIC supports only full-duplex operation, so this number should always remain 0. If it is incrementing, there is a software bug.                                                                            |
| <b>Drops</b>                | The number of packets dropped by the output queue of the I/O Manager ASIC.                                                             | If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.                                                                                                     |
| <b>Aged packets</b>         | The number of packets that remained in shared packet SDRAM for so long that the system automatically purged them.                      | The value in this field should never increment. If it increments, it is probably a software bug or broken hardware.                                                                                                          |

Table 77: Major Fast Ethernet and Gigabit Ethernet Counters (*continued*)

| Counter                                            | Description                                                                                                                                        | Reason for Increment                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HS link FCS errors, FIFO errors</b>             | The number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.                                     | The value in this field should always be 0. If it increments, either the FPC or the PIC is broken.                                                                                                                                                                                                                                                                         |
| <b>Miscellaneous Counters</b>                      |                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Input DA rejects</b>                            | The number of packets that the filter rejected because the destination Media Access Control (MAC) address of the packet is not on the accept list. | It is normal for this value to increment. When it increments very quickly and no traffic is entering the router from the far-end system, either there is a bad Address Resolution Protocol (ARP) entry on the far-end system, or multicast routing is not on and the far-end system is sending many multicast packets to the local router (which the router is rejecting). |
| <b>Output packet pad count</b>                     | The number of packets that the filter padded to the minimum Ethernet size (60 bytes) before giving the packet to the MAC hardware.                 | Usually, padding is done only on small ARP packets, but some very small Internet Protocol (IP) packets can also require padding. If this value increments rapidly, either the system is trying to find an ARP entry for a far-end system that does not exist, or it is misconfigured.                                                                                      |
| <b>Output packet error count</b>                   | Number of packets with an indicated error that the filter was given to transmit.                                                                   | These packets are usually aged packets or are the result of a bandwidth problem on the FPC hardware. On a normal system, the value of this field should not increment.                                                                                                                                                                                                     |
| <b>CAM destination filters, CAM source filters</b> | The number of entries in the content-addressable memory (CAM) dedicated to destination and source MAC address filters.                             | There can be up to 64 source entries. If source filtering is disabled, which is the default, the value for these fields should be 0.                                                                                                                                                                                                                                       |

## Troubleshooting: 10-Gigabit Ethernet Port Stuck in Down State

**Problem**    **Description:** 10-Gigabit Ethernet port is stuck in DPC or PIC down state.

**Environment:** Juniper Networks T Series and MX Series routers. Refer to the related documentation section for more information.

**Symptoms:** The device has failed to initialize because the Ethernet port is down.

**Diagnosis**    Try disabling and reenabling the interface and resetting the transceiver and cable. If the interface remains down, it can be stuck in DPC or PIC down state.

Does the router function normally after disabling and reenabling the interface and resetting the transceiver and cable?

**Yes:**

The system is not stuck in DPC or PIC down state. Disabling and reenabling the interface or resetting the transceiver, and cable resolved the issue.

**No:**



The interface might be stuck in DPC or PIC down state. Refer to the [“Resolution” on page 805](#) section for recovery options.

#### Resolution *To resolve the issue*

From the aforementioned diagnosis, you ascertain that the interface is stuck in DPC or PIC down state.

This is not a hardware defect. Implement one of the following solutions on the backup Routing Engine to resolve this issue:

- Reset the PIC.
  - Toggle the framing mode.
1. In configuration mode, go to the **[edit interfaces]** hierarchy level.
 

```
user@host1# edit interfaces interface name
```
  2. Toggle the framing mode. In the following configuration, WAN-PHY mode is toggled.
 

```
[edit interfaces interface-name is in the et-fpc/pic/port
user@host1# set framing wan-phy
user@host1# commit
user@host1# framing {
user@host1# wan-phy;
user@host1# }
user@host1# delete framing
user@host1# commit
```
  3. Reset the PIC (T Series Routers)
 

```
user@host1# request chassis pic fpc-slot x pic-slot y offline
user@host1# request chassis pic fpc-slot x pic-slot y online
```
  4. Reset the PIC (MX Series Routers)
 

```
user@host1# request chassis fpc slot x offline
user@host1# request chassis fpc slot x online
```

#### Related Documentation

- [Ethernet Interfaces Overview on page 3](#)
- [\[edit interfaces\] Hierarchy Level on page 822](#)
- [DPCs Supported on MX240, MX480, and MX960 Routers](#)
- [TI600 PICs Supported](#)



## PART 5

# Configuration Statements and Operational Commands

- Configuration Statements on page 809
- Operational Commands on page 1259



## CHAPTER 36

# Configuration Statements

- [\[edit chassis\] Hierarchy Level on page 821](#)
- [\[edit interfaces\] Hierarchy Level on page 822](#)
- [\[edit interfaces aex aggregated-ether-options load-balance\] Hierarchy Level on page 838](#)
- [\[edit interfaces aex forwarding-options\] Hierarchy Level on page 838](#)
- [\[edit logical-systems\] Hierarchy Level on page 839](#)
- [\[edit protocols authentication-access-control\] Configuration Statement Hierarchy on MX Series Routers on page 843](#)
- [\[edit protocols connections\] Hierarchy Level on page 845](#)
- [\[edit protocols dot1x\] Hierarchy Level on page 846](#)
- [\[edit protocols iccp\] Hierarchy Level on page 846](#)
- [\[edit protocols lacp\] Hierarchy Level on page 847](#)
- [\[edit protocols lldp\] Hierarchy Level on page 847](#)
- [\[edit protocols oam\] Hierarchy Level on page 847](#)
- [\[edit protocols ppp\] Hierarchy Level on page 850](#)
- [\[edit protocols pppoe\] Hierarchy Level on page 850](#)
- [\[edit protocols protection-group\] Hierarchy Level on page 851](#)
- [\[edit protocols vrrp\] Hierarchy Level on page 851](#)
- [\[edit security macsec\] Configuration Statement Hierarchy on MX Series Routers on page 852](#)
- [\[edit system processes\] Hierarchy Level on page 853](#)
- [802.3ad on page 854](#)
- [accept-source-mac on page 855](#)
- [access-concentrator on page 856](#)
- [account-layer2-overhead \(PIC Level\) on page 857](#)
- [action \(OAM\) on page 857](#)
- [action-profile \(Applying to CFM\) on page 858](#)
- [action-profile \(Defining for CFM\) on page 859](#)
- [action-profile \(Defining for LFM\) on page 860](#)

- [action-profile \(MEP\) on page 861](#)
- [adaptive on page 862](#)
- [address on page 863](#)
- [adjacency-loss on page 866](#)
- [advertisement-interval on page 867](#)
- [age on page 868](#)
- [agent-specifier on page 869](#)
- [aggregate \(Gigabit Ethernet CoS Policer\) on page 870](#)
- [aggregated-devices on page 871](#)
- [aggregated-ether-options on page 872](#)
- [ais-trigger-condition on page 873](#)
- [alarm \(optics-options\) on page 874](#)
- [alarms on page 874](#)
- [all-defects on page 875](#)
- [allow-remote-loopback on page 875](#)
- [apply-action-profile on page 876](#)
- [arp \(Interfaces\) on page 877](#)
- [asynchronous-notification on page 878](#)
- [authentication-access-control \(MX Series in Enhanced LAN Mode\) on page 879](#)
- [authentication-profile-name on page 880](#)
- [authenticator on page 881](#)
- [auto-discovery on page 882](#)
- [auto-negotiation on page 883](#)
- [auto-reconnect on page 884](#)
- [avg-fd-twoway-threshold on page 885](#)
- [avg-ifdv-twoway-threshold on page 886](#)
- [avg-flr-forward-threshold on page 887](#)
- [avg-flr-backward-threshold on page 888](#)
- [backward-frr-enable on page 889](#)
- [bandwidth-limit \(Policer for Gigabit Ethernet Interfaces\) on page 890](#)
- [bridge-domain on page 891](#)
- [bridge-domains on page 892](#)
- [ber-threshold-clear on page 894](#)
- [ber-threshold-signal-degrade on page 896](#)
- [bfd-liveness-detection \(LAG\) on page 899](#)
- [burst-size-limit \(Policer for Gigabit Ethernet Interfaces\) on page 901](#)
- [bypass on page 901](#)

- [bytes \(otn-options\) on page 902](#)
- [cak \(MX Series\) on page 902](#)
- [calculation-weight on page 903](#)
- [captive-portal \(MX Series in Enhanced LAN Mode\) on page 904](#)
- [captive-portal-custom-options \(MX Series in Enhanced LAN Mode\) on page 905](#)
- [centralized on page 907](#)
- [chassis on page 908](#)
- [ckn \(MX Series\) on page 908](#)
- [classifier on page 909](#)
- [clear on page 909](#)
- [client on page 910](#)
- [community-vlans \(MX Series\) on page 910](#)
- [compatibility-version on page 911](#)
- [connectivity-association \(MACsec Interfaces for MX Series\) on page 911](#)
- [connectivity-association \(MX Series\) on page 912](#)
- [connectivity-fault-management on page 914](#)
- [continuity-check on page 916](#)
- [control-channel on page 917](#)
- [convey-loss-threshold on page 917](#)
- [cross-connect-ccm on page 918](#)
- [cycle-time on page 918](#)
- [data-channel on page 919](#)
- [data-tlv-size on page 920](#)
- [default-actions on page 921](#)
- [delay on page 922](#)
- [delay \(PPPoE Service Name Tables\) on page 923](#)
- [delegate-server-processing on page 924](#)
- [delay-variation on page 924](#)
- [destination \(IPCP\) on page 925](#)
- [detect-loc on page 925](#)
- [device-count on page 926](#)
- [direction \(MX Series\) on page 927](#)
- [direction on page 928](#)
- [disable on page 929](#)
- [disable \(Link Protection\) on page 929](#)
- [disable \(802.1X for MX Series in Enhanced LAN Mode\) on page 930](#)
- [dot1p-priority on page 930](#)

- [dot1x](#) on page 931
- [dot1x \(MX Series in Enhanced LAN Mode\)](#) on page 932
- [domain-id](#) on page 933
- [drop \(PPPoE Service Name Tables\)](#) on page 933
- [dynamic-profile \(PPPoE Service Name Tables\)](#) on page 934
- [east-interface](#) on page 935
- [egress-policer-overhead](#) on page 936
- [encapsulation \(Logical Interface\)](#) on page 937
- [encapsulation \(Physical Interface\)](#) on page 941
- [encryption \(MACsec for MX Series\)](#) on page 946
- [erroneous-ccm](#) on page 947
- [ether-options](#) on page 948
- [ethernet \(Chassis\)](#) on page 949
- [ethernet \(Protocols OAM\)](#) on page 950
- [ethernet-policer-profile](#) on page 953
- [ethernet-ring](#) on page 954
- [ethernet-switch-profile](#) on page 955
- [evcs](#) on page 957
- [evc-protocol cfm](#) on page 958
- [event \(LFM\)](#) on page 959
- [event-thresholds](#) on page 959
- [exclude-protocol \(MX Series\)](#) on page 960
- [exercise](#) on page 960
- [failover-delay](#) on page 961
- [family](#) on page 962
- [fast-aps-switch](#) on page 966
- [fastether-options](#) on page 967
- [fec](#) on page 968
- [fixed-stuff-bytes](#) on page 969
- [flexible-vlan-tagging](#) on page 970
- [flow-control](#) on page 971
- [fnp](#) on page 972
- [force switch](#) on page 972
- [force-up](#) on page 973
- [forwarding-class \(Gigabit Ethernet IQ Classifier\)](#) on page 973
- [forwarding-mode \(100-Gigabit Ethernet\)](#) on page 974
- [forwarding-mode \(PTX Series Packet Transport Routers\)](#) on page 975



- [frame-error](#) on page 976
- [frame-period](#) on page 977
- [frame-period-summary](#) on page 978
- [framing \(10-Gigabit Ethernet Interfaces\)](#) on page 979
- [gether-options](#) on page 980
- [gratuitous-arp-reply](#) on page 981
- [guest-vlan \(MX Series in Enhanced LAN Mode\)](#) on page 982
- [guard-interval](#) on page 983
- [hardware-assisted-timestamping](#) on page 984
- [hardware-assisted-keepalives](#) on page 985
- [hold-interval \(OAM\)](#) on page 986
- [hold-interval \(Protection Group\)](#) on page 986
- [hold-multiplier](#) on page 987
- [iccp](#) on page 988
- [id \(MACsec for MX Series\)](#) on page 989
- [ieee802.1p](#) on page 989
- [igmp-snooping](#) on page 990
- [ignore-l3-incompletes](#) on page 991
- [include-sci \(MACsec for MX Series\)](#) on page 992
- [ingress-policer-overhead](#) on page 993
- [ingress-rate-limit](#) on page 994
- [inner-tag-protocol-id](#) on page 995
- [inner-vlan-id](#) on page 996
- [input-policer](#) on page 997
- [input-priority-map](#) on page 998
- [input-three-color](#) on page 999
- [input-vlan-map \(Aggregated Ethernet\)](#) on page 1000
- [input-vlan-map](#) on page 1001
- [instance](#) on page 1002
- [interface](#) on page 1003
- [interface \(IEEE 802.1x\)](#) on page 1004
- [interface \(OAM Link-Fault Management\)](#) on page 1005
- [interface \(Static MAC Bypass\)](#) on page 1006
- [interface-down](#) on page 1006
- [interfaces](#) on page 1007
- [interfaces \(MACsec for MX Series\)](#) on page 1008
- [interface-none](#) on page 1009

- [interface-status-tlv](#) on page 1009
- [interval](#) on page 1010
- [interval \(CFM MEP\)](#) on page 1011
- [is-ma](#) on page 1012
- [isolated-vlan \(MX Series\)](#) on page 1013
- [iteration-count](#) on page 1014
- [iteration-period](#) on page 1014
- [key \(MACsec for MX Series\)](#) on page 1015
- [key-server-priority \(MACsec for MX Series\)](#) on page 1016
- [lACP \(802.3ad\)](#) on page 1017
- [lACP \(Aggregated Ethernet\)](#) on page 1018
- [laser-enable](#) on page 1019
- [layer2-policer](#) on page 1020
- [level](#) on page 1021
- [level \(CFM MEP\)](#) on page 1021
- [line-loopback](#) on page 1022
- [linktrace](#) on page 1022
- [link-adjacency-loss](#) on page 1023
- [link-discovery](#) on page 1023
- [link-down](#) on page 1024
- [link-event-rate](#) on page 1024
- [link-fault-management](#) on page 1025
- [link-mode](#) on page 1027
- [link-protection](#) on page 1028
- [link-speed \(Aggregated Ethernet\)](#) on page 1029
- [link-speed \(Aggregated SONET/SDH\)](#) on page 1031
- [lldp](#) on page 1032
- [lldp-configuration-notification-interval](#) on page 1033
- [lmi \(Ethernet OAM\)](#) on page 1034
- [load-balance](#) on page 1035
- [load-balance-stateful \(Aggregated Ethernet Interfaces\)](#) on page 1036
- [load-type \(Aggregated Ethernet Interfaces\)](#) on page 1037
- [local-loopback](#) on page 1038
- [lockout](#) on page 1038
- [log-and-generate-ais](#) on page 1039
- [logical-interface-policer](#) on page 1040
- [loopback \(Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet\)](#) on page 1041

- [loopback \(Local and Remote\) on page 1042](#)
- [loopback-tracking on page 1042](#)
- [loss-priority on page 1043](#)
- [loss-threshold on page 1043](#)
- [lowest-priority-defect on page 1044](#)
- [mac on page 1045](#)
- [mac \(IRB\) on page 1045](#)
- [mac-address \(Accept Source Mac\) on page 1046](#)
- [mac-address \(MACsec\) on page 1047](#)
- [mac-learn-enable on page 1048](#)
- [mac-radius \(MX Series in Enhanced LAN Mode\) on page 1049](#)
- [mac-validate on page 1050](#)
- [macsec \(MX Series\) on page 1051](#)
- [maintenance-association on page 1052](#)
- [maintenance-domain on page 1053](#)
- [major-ring-name on page 1054](#)
- [manual switch on page 1055](#)
- [master-only on page 1055](#)
- [max-sessions \(PPPoE Service Name Tables\) on page 1056](#)
- [max-sessions-vsa-ignore \(Static and Dynamic Subscribers\) on page 1057](#)
- [maximum-links on page 1058](#)
- [maximum-requests on page 1059](#)
- [maximum-requests \(MX Series in Enhanced LAN Mode\) on page 1059](#)
- [mc-ae on page 1060](#)
- [measurement-type on page 1062](#)
- [mep on page 1063](#)
- [minimum-bandwidth \(aggregated Ethernet\) on page 1064](#)
- [minimum-links on page 1065](#)
- [mip-half-function on page 1066](#)
- [mixed-rate-mode on page 1067](#)
- [mka \(MX Series\) on page 1067](#)
- [monitor-end-point on page 1068](#)
- [must-secure \(MX Series\) on page 1069](#)
- [mtu on page 1070](#)
- [multicast-router-interface \(IGMP Snooping\) on page 1074](#)
- [multi-chassis-protection on page 1075](#)
- [name-format on page 1076](#)

- [native-vlan-id](#) on page 1077
- [negotiate-address](#) on page 1078
- [negotiation-options](#) on page 1079
- [no-adaptive](#) on page 1079
- [no-allow-link-events](#) on page 1080
- [no-encryption](#) (MACsec for MX Series) on page 1080
- [no-auto-mdix](#) on page 1081
- [no-gratuitous-arp-request](#) on page 1081
- [no-keepalives](#) on page 1082
- [no-mac-table-binding](#) (802.1X for MX Series in Enhanced LAN Mode) on page 1082
- [no-odu-backward-frr-enable](#) on page 1083
- [no-odu-signal-degrade-monitor-enable](#) on page 1083
- [no-pre-classifier](#) on page 1084
- [no-reauthentication](#) (MX Series in Enhanced LAN Mode) on page 1084
- [no-send-pads-ac-info](#) on page 1085
- [no-send-pads-error](#) on page 1085
- [non-revertive](#) (Interfaces) on page 1086
- [non-revertive](#) on page 1086
- [non-vc-mode](#) on page 1087
- [node-id](#) on page 1087
- [number-of-frames](#) on page 1088
- [offset](#) (MX Series) on page 1089
- [oam](#) on page 1091
- [oc192](#) on page 1093
- [odu-delay-management](#) on page 1094
- [odu-backward-frr-enable](#) on page 1094
- [odu-signal-degrade](#) on page 1095
- [odu-signal-degrade-monitor-enable](#) on page 1096
- [odu-ttim-action-enable](#) on page 1096
- [optics-options](#) on page 1097
- [otn-options](#) on page 1098
- [otu-ttim-action-enable](#) on page 1099
- [otu4](#) on page 1100
- [output-policer](#) on page 1101
- [output-priority-map](#) on page 1102
- [output-three-color](#) on page 1103
- [output-vlan-map](#) (Aggregated Ethernet) on page 1104

- [output-vlan-map \(Gigabit Ethernet IQ and 10-Gigabit Ethernet with SFPP\) on page 1105](#)
- [pado-advertise on page 1106](#)
- [pass-through on page 1106](#)
- [passive-monitor-mode on page 1107](#)
- [path-database-size on page 1108](#)
- [pdu-interval on page 1108](#)
- [pdu-threshold on page 1109](#)
- [per-flow \(Aggregated Ethernet Interfaces\) on page 1109](#)
- [peer on page 1110](#)
- [performance-monitoring on page 1111](#)
- [periodic on page 1112](#)
- [policer \(CFM Firewall\) on page 1113](#)
- [policer \(CFM Global\) on page 1114](#)
- [policer \(CFM Session\) on page 1115](#)
- [policer \(CoS\) on page 1116](#)
- [policer \(MAC\) on page 1117](#)
- [pop on page 1118](#)
- [pop-pop on page 1119](#)
- [pop-swap on page 1120](#)
- [port-description-type on page 1121](#)
- [port-id \(MACsec for MX Series\) on page 1122](#)
- [port-priority on page 1123](#)
- [port-id-subtype on page 1124](#)
- [port-status-tlv on page 1125](#)
- [pp0 \(Dynamic PPPoE\) on page 1126](#)
- [ppm \(Ethernet Switching\) on page 1127](#)
- [pppoe-options on page 1128](#)
- [pppoe-underlying-options \(Static and Dynamic Subscribers\) on page 1129](#)
- [pre-shared-key \(MX Series\) on page 1130](#)
- [premium \(Output Priority Map\) on page 1131](#)
- [premium \(Policer\) on page 1131](#)
- [priority \(Protocols OAM\) on page 1132](#)
- [priority \(CFM MEP\) on page 1132](#)
- [priority \(OAM Connectivity-Fault Management\) on page 1133](#)
- [propagate-tc on page 1133](#)
- [protection-group on page 1134](#)
- [protocols on page 1136](#)

- [protocol \(Server MEP\) on page 1137](#)
- [protocol-down on page 1137](#)
- [ptopo-configuration-maximum-hold-time on page 1138](#)
- [ptopo-configuration-trap-interval on page 1138](#)
- [push on page 1139](#)
- [push-push on page 1140](#)
- [prbs on page 1140](#)
- [preemptive-fast-reroute on page 1141](#)
- [premium \(Output Priority Map\) on page 1142](#)
- [premium \(Policer\) on page 1142](#)
- [protect-maintenance-association \(OAM\) on page 1143](#)
- [proxy on page 1143](#)
- [proxy-arp on page 1144](#)
- [push on page 1145](#)
- [push-push on page 1146](#)
- [quiet-period on page 1147](#)
- [quiet-period \(MX Series in Enhanced LAN Mode\) on page 1147](#)
- [rate on page 1148](#)
- [reauthentication on page 1149](#)
- [reauthentication \(MX Series in Enhanced LAN Mode\) on page 1149](#)
- [rebalance \(Aggregated Ethernet Interfaces\) on page 1150](#)
- [receive-ais on page 1150](#)
- [receive-options-packets on page 1151](#)
- [receive-ttl-exceeded on page 1151](#)
- [remote on page 1152](#)
- [remote-loopback on page 1152](#)
- [remote-maintenance-association \(OAM\) on page 1153](#)
- [remote-mep on page 1153](#)
- [replay-window-size \(MX Series\) on page 1154](#)
- [replay-protect \(MX Series\) on page 1155](#)
- [restore-interval on page 1156](#)
- [retries on page 1157](#)
- [retries \(MX Series in Enhanced LAN Mode\) on page 1157](#)
- [revertive on page 1158](#)
- [ring-id on page 1158](#)
- [ring-protection-link-end on page 1159](#)
- [ring-protection-link-owner on page 1159](#)

- [routing-instance](#) on page 1160
- [routing-instance \(PPPoE Service Name Tables\)](#) on page 1161
- [sa-multicast \(100-Gigabit Ethernet\)](#) on page 1162
- [sa-multicast \(PTX Series Packet Transport Routers\)](#) on page 1163
- [secure-authentication \(MX Series in Enhanced LAN Mode\)](#) on page 1164
- [secure-channel](#) on page 1165
- [security-association](#) on page 1166
- [send-critical-event](#) on page 1167
- [server](#) on page 1167
- [server-fail](#) on page 1168
- [server-reject-vlan \(MX Series in Enhanced LAN Mode\)](#) on page 1169
- [server-timeout](#) on page 1170
- [server-timeout \(MX Series in Enhanced LAN Mode\)](#) on page 1170
- [service \(PPPoE\)](#) on page 1171
- [service-name](#) on page 1172
- [service-name-table](#) on page 1173
- [service-name-tables](#) on page 1174
- [session-expiry \(MX Series in Enhanced LAN Mode\)](#) on page 1175
- [short-name-format](#) on page 1176
- [signal-degrade](#) on page 1177
- [signal-degrade-monitor-enable](#) on page 1178
- [source-address-filter](#) on page 1180
- [source-filtering](#) on page 1181
- [speed \(Ethernet\)](#) on page 1182
- [speed \(MX Series DPC\)](#) on page 1183
- [sla-iterator-profile](#) on page 1184
- [sla-iterator-profiles](#) on page 1185
- [stacked-vlan-tagging](#) on page 1186
- [static \(Protocols 802.1X\)](#) on page 1187
- [static-interface](#) on page 1188
- [start-measurement](#) on page 1189
- [supplicant](#) on page 1189
- [supplicant \(MX Series in Enhanced LAN Mode\)](#) on page 1190
- [supplicant-timeout](#) on page 1191
- [supplicant-timeout \(MX Series in Enhanced LAN Mode\)](#) on page 1191
- [swap](#) on page 1192
- [swap-by-poppush](#) on page 1192

- [swap-push on page 1193](#)
- [swap-swap on page 1194](#)
- [switch-options on page 1194](#)
- [switch-port on page 1195](#)
- [symbol-period on page 1196](#)
- [syslog \(OAM Action\) on page 1196](#)
- [system-id on page 1197](#)
- [system-priority on page 1198](#)
- [tag-protocol-id \(TPIDs Expected to Be Sent or Received\) on page 1199](#)
- [tag-protocol-id \(TPID to Rewrite\) on page 1200](#)
- [tca on page 1201](#)
- [terminate \(PPPoE Service Name Tables\) on page 1203](#)
- [traceoptions on page 1204](#)
- [traceoptions \(Ethernet Ring Protection\) on page 1206](#)
- [traceoptions \(Interface Process\) on page 1208](#)
- [traceoptions \(LACP\) on page 1210](#)
- [traceoptions \(PPPoE\) on page 1212](#)
- [traceoptions \(802.1X and Captive Portal for MX Series in Enhanced LAN Mode\) on page 1215](#)
- [transmit-delay on page 1216](#)
- [transmit-interval \(MACsec for MX Series\) on page 1217](#)
- [transmit-period on page 1218](#)
- [transmit-period \(MX Series in Enhanced LAN Mode\) on page 1218](#)
- [transport-monitoring on page 1219](#)
- [trigger on page 1220](#)
- [tti on page 1225](#)
- [tx-power on page 1226](#)
- [uac-policy \(MX Series in Enhanced LAN Mode\) on page 1226](#)
- [underlying-interface on page 1227](#)
- [unit on page 1228](#)
- [unnumbered-address \(PPP\) on page 1234](#)
- [version-3 on page 1235](#)
- [virtual-control-channel on page 1236](#)
- [virtual-switch on page 1236](#)
- [vlan-assignment on page 1237](#)
- [vlan-id \(VLAN ID to Be Bound to a Logical Interface\) on page 1237](#)
- [vlan-id \(VLAN ID to Rewrite\) on page 1238](#)



- [vlan-id-list \(Ethernet VLAN Circuit\)](#) on page 1239
- [vlan-id-list \(Interface in Bridge Domain\)](#) on page 1241
- [vlan-id-range](#) on page 1242
- [vlan-rewrite](#) on page 1243
- [vlan-rule \(100-Gigabit Ethernet Type 4 PIC with CFP\)](#) on page 1244
- [vlan-steering \(100-Gigabit Ethernet Type 4 PIC with CFP\)](#) on page 1245
- [vlan-tagging](#) on page 1246
- [vlan-tags](#) on page 1247
- [vlan-tags \(Dual-Tagged Logical Interface\)](#) on page 1248
- [vlan-tags \(Stacked VLAN Tags\)](#) on page 1250
- [wait-to-block-interval](#) on page 1251
- [warning](#) on page 1252
- [wavelength](#) on page 1253
- [west-interface](#) on page 1257

## [\[edit chassis\]](#) Hierarchy Level

```

chassis {
  aggregated-devices {
    ethernet {
      device-count number;
    }
    sonet {
      device-count number;
    }
  }
  maximum-links {
  }
  channel-group number {
    ethernet {
      device-count number;
    }
    fpc slot-number {
      pic pic-number {
        adaptive-services {
          service-package (layer-2 | layer-3);
        }
        aggregate-ports;
        atm-cell-relay-accumulation;
        atm-l2circuit-mode (aal5 | cell | trunk trunk);
        cel {
          el link-number {
            channel-group group-number;
            timeslots time-slot-range;
          }
        }
        channelization;
        ct1 {
          t1 link-number {

```

```

        channel-group group-number;
        timeslots time-slot-range;
    }
}
ct3 {
    port port-number {
        t1 link-number {
            channel-group group-number;
            timeslots time-slot-range;
        }
    }
    framing sdh;
}
max-queues-per-interface number;
mlfr-uni-nni-bundles num-intf;
no-concatenate;
shdsl {
    pic-mode (1-port-atm | 2-port-atm);
}
vtmapping (klm | itu-t);
}
}
fpc slot-number{
pic pic-number{
    account-layer2-overhead
    egress-policer-overhead bytes;
    ingress-policer-overhead bytes;
    mlfr-uni-nni-bundles-inline number;
    multi-link-layer-2-inline;
}
}
}

```

#### Related Documentation

- [Interfaces Fundamentals for Routing Devices](#)

## [edit interfaces] Hierarchy Level

The statements at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level can also be configured at the [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*] hierarchy level.



**NOTE:** The *accounting-profile* statement is an exception to this rule. The *accounting-profile* statement can be configured at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level, but it cannot be configured at the [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

```

interfaces {
    traceoptions {
        file filename <files number> <match regular-expression> <size size> <world-readable | no-world-readable> ;
    }
}

```

```

    flag flag <disable>;
}
interface-name {
    accounting-profile name;
    aggregated-ether-options {
        (flow-control | no-flow-control);
        lcp {
            (active | passive);
            link-protection {
                disable;
                (revertive | non-revertive);
                periodic interval;
                system-priority priority;
            }
        }
        link-protection;
        link-speed speed;
        (loopback | no-loopback);
        mc-ae {
            chassis-id chassis-id;
            mc-ae-id mc-ae-id;
            mode (active-active | active-standby);
            redundancy-group group-id;
            status-control (active | standby);
        }
        minimum-links number;
        source-address-filter {
            mac-address;
        }
        (source-filtering | no-source-filtering);
    }
    shared-scheduler;
    aggregated-sonet-options {
        link-speed speed | mixed;
        minimum-links number;
    }
    atm-options {
        cell-bundle-size cells;
        ilmi;
        linear-red-profiles profile-name {
            high-plp-max-threshold percent;
            low-plp-max-threshold percent;
            queue-depth cells high-plp-threshold percent low-plp-threshold percent;
        }
        mpls {
            pop-all-labels {
                required-depth number;
            }
        }
        pic-type (atm1 | atm2);
        plp-to-clp;
        promiscuous-mode {
            vpi vpi-identifier;
        }
        scheduler-maps map-name {
            forwarding-class class-name {
                epd-threshold cells plp1 cells;
            }
        }
    }
}

```

```
        linear-red-profile profile-name;  
        priority (high | low);  
        transmit-weight (cells number | percent number);  
    }  
    vc-cos-mode (alternate | strict);  
}  
use-null-cw;  
vpi vpi-identifier {  
    maximum-vcs maximum-vcs;  
    oam-liveness {  
        down-count cells;  
        up-count cells;  
    }  
    oam-period (seconds | disable);  
    shaping {  
        (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate  
        burst length);  
        queue-length number;  
    }  
}  
}  
clocking clock-source;  
damping {  
    enable;  
    half-life seconds;  
    max-suppress seconds;  
    reuse number;  
    suppress number;  
}  
data-input (system | interface interface-name);  
dce;  
serial-options {  
    clock-rate rate;  
    clocking-mode (dce | internal | loop);  
    control-polarity (negative | positive);  
    cts-polarity (negative | positive);  
    dcd-polarity (negative | positive);  
    dce-options {  
        control-signal (assert | de-assert | normal);  
        cts (ignore | normal | require);  
        dcd (ignore | normal | require);  
        dsr (ignore | normal | require);  
        dtr signal-handling-option;  
        ignore-all;  
        indication (ignore | normal | require);  
        rts (assert | de-assert | normal);  
        tm (ignore | normal | require);  
    }  
    dsr-polarity (negative | positive);  
    dte-options {  
        control-signal (assert | de-assert | normal);  
        cts (ignore | normal | require);  
        dcd (ignore | normal | require);  
        dsr (ignore | normal | require);  
        dtr signal-handling-option;  
        ignore-all;
```

```

    indication (ignore | normal | require);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
}
dtr-circuit (balanced | unbalanced);
dtr-polarity (negative | positive);
encoding (nrz | nrzi);
indication-polarity (negative | positive);
line-protocol protocol;
loopback mode;
rts-polarity (negative | positive);
tm-polarity (negative | positive);
transmit-clock invert;
}
description text;
alias alias-name;
dialer-options {
    pool pool-name <priority priority>;
}
disable;
ds0-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback payload;
    start-end-flag (filler | shared);
}
e1-options {
    bert-error-rate rate;
    bert-period seconds;
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback (local | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
e3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    framing feet;
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
    fcs (16 | 32);
    framing (g.751 | g.832);
    idle-cycle-flag (filler | shared);
    invert-data;
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
}

```

```

    (unframed | no-unframed);
}
encapsulation type;
es-options {
    backup-interface es-fpc/pic/port;
}
fastether-options {
    802.3ad aex;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    ingress-rate-limit rate;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
flexible-vlan-tagging;
gigether-options {
    802.3ad aex;
    (asynchronous-notification | no-asynchronous-notification);
    (auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
        local-interface-offline>;
    auto-reconnect seconds;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    no-auto-mdix;
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
    ethernet-switch-profile {
        (mac-learn-enable | no-mac-learn-enable);
        tag-protocol-id [ tpids ];
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
        }
    }
}

```

827

```

    tei-option (first-call | power-up);
}
keepalives <down-count number> <interval seconds> <up-count number>;
link-mode mode;
lmi {
    lmi-type (ansi | itu | c-lmi);
    n391dte number;
    n392dce number;
    n392dte number;
    n393dce number;
    n393dte number;
    t391dte seconds;
    t392dce seconds;
}
lsq-failure-options {
    no-termination-request;
    [ trigger-link-failure interface-name ];
}
mac mac-address;
mlfr-uni-nni-bundle-options {
    acknowledge-retries number;
    acknowledge-timer milliseconds;
    action-red-differential-delay (disable-tx | remove-link);
    drop-timeout milliseconds;
    fragment-threshold bytes;
    cisco-interoperability send-lip-remove-link-for-link-reject;
    hello-timer milliseconds;
    link-layer-overhead percent;
    lmi-type (ansi | itu | c-lmi);
    minimum-links number;
    mrru bytes;
    n391 number;
    n392 number;
    n393 number;
    red-differential-delay milliseconds;
    t391 seconds;
    t392 seconds;
    yellow-differential-delay milliseconds;
}
modem-options {
    dialin (console | routable);
    init-command-string initialization-command-string;
}
mtu bytes;
multi-chassis-protection {
    peer a.b.c.d {
        interface interface-name;
    }
}
multiservice-options {
    (core-dump | no-core-dump);
    (syslog | no-syslog);
}
native-vlan-id number;
no-gratuitous-arp-request;
no-keepalives;

```



```

no-partition {
    interface-type type;
}
no-vpivci-swapping;
otn-options {
    fec (efec | gfec | none);
    (laser-enable | no-laser-enable);
    (line-loopback | no-line-loopback);
    pass-thru;
    rate (fixed-stuff-bytes | no-fixed-stuff-bytes | pass-thru);
    transmit-payload-type number;
    trigger (oc-lof | oc-lom | oc-los | oc-wavelength-lock | odu-ais | odu-bbe-th | odu-bdi
        | odu-es-th | odu-lck | odu-oci | odu-sd | odu-ses-th | odu-ttim | odu-uas-th |
        opu-ptm | otu-ais | otu-bbe-th | otu-bdi | otu-es-th | otu-fec-deg | otu-fec-exe |
        otu-iae | otu-sd | otu-ses-th | otu-ttim | otu-uas-th);
    tti;
}
optics-options {
    wavelength nm;
    alarm alarm-name {
        (syslog | link-down);
    }
    warning warning-name {
        (syslog | link-down);
    }
}
partition partition-number oc-slice oc-slice-range interface-type type;
timeslots time-slot-range;
passive-monitor-mode;
per-unit-scheduler;
ppp-options {
    chap {
        access-profile name;
        default-chap-secret name;
        local-name name;
        passive;
    }
    compression {
        acfc;
        pfc;
    }
    dynamic-profile profile-name;
    no-termination-request;
    pap {
        access-profile name;
        local-name name;
        local-password password;
        compression;
    }
}
psn-vcip psn-vci-identifier;
psn-vpip psn-vpi-identifier;
receive-bucket {
    overflow (discard | tag);
    rate percentage;
    threshold bytes;
}

```

```
}
redundancy-options {
  priority sp-fpc/pic/port;
  secondary sp-fpc/pic/port;
  hot-standby;
}
satop-options {
  payload-size n;
}
schedulers number;
serial-options {
  clock-rate rate;
  clocking-mode (dce | internal | loop);
  control-polarity (negative | positive);
  cts-polarity (negative | positive);
  dcd-polarity (negative | positive);
  dce-options {
    control-signal (assert | de-assert | normal);
    cts (ignore | normal | require);
    dcd (ignore | normal | require);
    dsr (ignore | normal | require);
    dtr signal-handling-option;
    ignore-all;
    indication (ignore | normal | require);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
  }
  dsr-polarity (negative | positive);
  dte-options {
    control-signal (assert | de-assert | normal);
    cts (ignore | normal | require);
    dcd (ignore | normal | require);
    dsr (ignore | normal | require);
    dtr signal-handling-option;
    ignore-all;
    indication (ignore | normal | require);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
  }
  dtr-circuit (balanced | unbalanced);
  dtr-polarity (negative | positive);
  encoding (nrz | nrzi);
  indication-polarity (negative | positive);
  line-protocol protocol;
  loopback mode;
  rts-polarity (negative | positive);
  tm-polarity (negative | positive);
  transmit-clock invert;
}
services-options {
  inactivity-timeout seconds;
  open-timeout seconds;
  session-limit {
    maximum number;
    rate new-sessions-per-second;
  }
}
```

```

    syslog {
        host hostname {
            facility-override facility-name;
            log-prefix prefix-number;
            services priority-level;
        }
    }
}
shdsl-options {
    annex (annex-a | annex-b);
    line-rate line-rate;
    loopback (local | remote);
    snr-margin {
        snext margin;
    }
}
sonet-options {
    aggregate asx;
    aps {
        advertise-interval milliseconds;
        annex-b;
        authentication-key key;
        fast-aps-switch;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
        preserve-interface;
        protect-circuit group-name;
        request;
        revert-time seconds;
        switching-mode (bidirectional | unidirectional);
        working-circuit group-name;
    }
    bytes {
        c2 value;
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
    }
    fcs (16 | 32);
    loopback (local | remote);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore;
    }
}

```

```

        hold-time up milliseconds down milliseconds;
    }
    vtmapping (itu-t | klm);
    (z0-increment | no-z0-increment);
}
speed (10m | 100m | 1g | oc3 | oc12 | oc48);
stacked-vlan-tagging;
switch-options {
    switch-port port-number {
        (auto-negotiation | no-auto-negotiation);
        speed (10m | 100m | 1g);
        link-mode (full-duplex | half-duplex);
    }
}
t1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout value;
    byte-encoding (nx56 | nx64);
    crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
    crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
    fcs (16 | 32);
    framing (esf | sf);
    idle-cycle-flag (flags | ones);
    invert-data;
    line-encoding (ami | b8zs);
    loopback (local | payload | remote);
    remote-loopback-respond;
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
t3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    (cbit-parity | no-cbit-parity);
    compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate
        value>;
    fcs (16 | 32);
    (feac-loop-respond | no-feac-loop-respond);
    idle-cycle-flag value;
    (long-buildout | no-long-buildout);
    (loop-timing | no-loop-timing);
    loopback (local | payload | remote);
    (mac | no-mac);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
}
traceoptions {
    flag flag <flag-modifier> <disable>;
}
transmit-bucket {
    overflow discard;
}

```

```

    rate percentage;
    threshold bytes;
}
(traps | no-traps);
unidirectional;
vlan-tagging;
vlan-vci-tagging;
unit logical-unit-number {
    accept-source-mac {
        mac-address mac-address {
            policer {
                input cos-policer-name;
                output cos-policer-name;
            }
        }
    }
}
accounting-profile name;
advisory-options {
    downstream-rate rate;
    upstream-rate rate;
}
allow-any-vci;
atm-scheduler-map (map-name | default);
backup-options {
    interface interface-name;
}
bandwidth rate;
cell-bundle-size cells;
clear-dont-fragment-bit;
compression {
    rtp {
        f-max-period number;
        maximum-contexts number <force>;
        queues [ queue-numbers ];
        port {
            minimum port-number;
            maximum port-number;
        }
    }
}
compression-device interface-name;
copy-tos-to-outer-ip-header;
demux-destination family;
demux-source family;
demux-options {
    underlying-interface interface-name;
}
description text;
alias alias-name;
interface {
    l2tp-interface-id name;
    (dedicated | shared);
}
dialer-options {
    activation-delay seconds;
    callback;
}

```

```

callback-wait-period time;
deactivation-delay seconds;
dial-string [ dial-string-numbers ];
idle-timeout seconds;
incoming-map {
    caller (caller-id | accept-all);
    initial-route-check seconds;
    load-interval seconds;
    load-threshold percent;
    pool pool-name;
    redial-delay time;
    watch-list {
        [ routes ];
    }
}
}
disable;
disable-mlppp-inner-ppp-pfc;
dlci dlci-identifier;
drop-timeout milliseconds;
dynamic-call-admission-control {
    activation-priority priority;
    bearer-bandwidth-limit kilobits-per-second;
}
encapsulation type;
epd-threshold cells plp1 cells;
fragment-threshold bytes;
inner-vlan-id-range start start-id end end-id;
input-vlan-map {
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
    inner-tag-protocol-id tpid;
    inner-vlan-id number;
    tag-protocol-id tpid;
    vlan-id number;
}
interleave-fragments;
inverse-arp;
layer2-policer {
    input-policer policer-name;
    input-three-color policer-name;
    output-policer policer-name;
    output-three-color policer-name;
}
link-layer-overhead percent;
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
    down-count cells;
    up-count cells;
}
oam-period (seconds | disable);
output-vlan-map {

```

```

(pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
inner-tag-protocol-id tpid;
inner-vlan-id number;
tag-protocol-id tpid;
vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
    chap {
        access-profile name;
        default-chap-secret name;
        local-name name;
        passive;
    }
    compression {
        acfc;
        pfc;
        pap;
        default-pap-password password;
        local-name name;
        local-password password;
        passive;
    }
    dynamic-profile profile-name;
    lcp-max-conf-req number;
    lcp-restart-timer milliseconds;
    loopback-clear-timer seconds;
    ncp-max-conf-req number;
    ncp-restart-timer milliseconds;
}
pppoe-options {
    access-concentrator name;
    auto-reconnect seconds;
    (client | server);
    service-name name;
    underlying-interface interface-name;
}
proxy-arp;
service-domain (inside | outside);
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
    burst length);
    queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;

```

```

routing-instance {
    destination routing-instance-name;
}
source source-address;
ttl number;
}
vci vpi-identifier.vci-identifier;
vci-range start start-vci end end-vci;
vpi vpi-identifier;
vlan-id number;
vlan-id-list [vlan-id vlan-id-vlan-id];
vlan-id-range number-number;
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
vlan-tags-outer tpid.vlan-id inner-list [vlan-id vlan-id-vlan-id];
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
        }
    }
}
access-concentrator name;
address address {
    destination address;
}
bundle ml-fpc/pic/port | ls-fpc/pic/port;
direct-connect;
duplicate-protection;
dynamic-profile profile-name;
filter {
    group filter-group-number;
    input filter-name;
    input-list {
        [filter-names];
        output filter-name;
    }
    output-list {
        [filter-names];
    }
}
ipsec-sa sa-name;
keep-address-and-control;
max-sessions number;
max-sessions-vsa-ignore;
mtu bytes;
multicast-only;
negotiate-address;
no-redirects;
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
proxy inet-address address;
receive-options-packets;

```



```

receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check {
    fail-filter filter-name;
    mode loose;
}
sampling {
    direction;
}
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-names <service-filter filter-name>;
    }
}
service-name-table table-name;
short-cycle-protection <lockout-time-min minimum-seconds lockout-time-max
    maximum-seconds>;
targeted-broadcast {
    forward-and-send-to-re;
    forward-only;
}
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
translate-plp-control-word-de;
unnumbered-address interface-name <destination address destination-profile
    profile-name | preferred-source-address address>;
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    multipoint-destination address (dlci dlci-identifier | vci vci-identifier);
    multipoint-destination address {
        epd-threshold cells plp1 cells;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (seconds | disable);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
            queue-length number;
        }
        vci vpi-identifier.vci-identifier;
    }
    preferred;
    primary;
    (vrrp-group | vrrp-inet6-group) group-number {
        (accept-data | no-accept-data);
    }
}

```

```
advertise-interval seconds;  
authentication-type authentication;  
authentication-key key;  
fast-interval milliseconds;  
(preempt | no-preempt) {  
    hold-time seconds;  
}  
priority-number number;  
track {  
    priority-cost seconds;  
    priority-hold-time interface-name {  
        bandwidth-threshold bits-per-second {  
            priority;  
        }  
        interface priority;  
    }  
    route ip-address/mask routing-instance instance-name priority-cost cost;  
}  
virtual-address [ addresses ];  
}  
}  
}  
}
```

**Related Documentation**

- [Junos OS Hierarchy and RFC Reference](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Junos OS Network Interfaces Library for Routing Devices](#)

---

**[edit interfaces aex aggregated-ether-options load-balance] Hierarchy Level**

---

```
aggregated-ether-options {  
    load-balance {  
        adaptive {  
            tolerance;  
        }  
        no-adaptive;  
        per-packet;  
    }  
}
```

---

**[edit interfaces aex forwarding-options] Hierarchy Level**

---

```
load-balance-stateful {  
    per-flow;  
    rebalance interval;  
    load-type (low | medium | large);  
}
```

## [edit logical-systems] Hierarchy Level

The following lists the statements that can be configured at the **[edit logical-systems]** hierarchy level that are also documented in this manual. For more information about logical systems, see the *Logical Systems Feature Guide for Routing Devices*.

```
logical-systems logical-system-name {
  interfaces interface-name {
    unit logical-unit-number {
      accept-source-mac {
        mac-address mac-address {
          policer {
            input cos-policer-name;
            output cos-policer-name;
          }
        }
      }
    }
    allow-any-vci;
    atm-scheduler-map (map-name | default);
    bandwidth rate;
    backup-options {
      interface interface-name;
    }
    cell-bundle-size cells;
    clear-dont-fragment-bit;
    compression {
      rtp {
        f-max-period number;
        port {
          minimum port-number;
          maximum port-number;
        }
      }
      queues [ queue-numbers ];
    }
  }
  compression-device interface-name;
  description text;
  interface {
    l2tp-interface-id name;
    (dedicated | shared);
  }
  dialer-options {
    activation-delay seconds;
    deactivation-delay seconds;
    dial-string [ dial-string-numbers ];
    idle-timeout seconds;
    initial-route-check seconds;
    load-threshold number;
    pool pool;
    remote-name remote-callers;
    watch-list {
      [ routes ];
    }
  }
}
```

```

disable;
dlci dlci-identifier;
drop-timeout milliseconds;
dynamic-call-admission-control {
    activation-priority priority;
    bearer-bandwidth-limit kilobits-per-second;
}
encapsulation type;
epd-threshold cells plp1 cells;
fragment-threshold bytes;
input-vlan-map {
    inner-tag-protocol-id;
    inner-vlan-id;
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
    tag-protocol-id tpid;
    vlan-id number;
}
interleave-fragments;
inverse-arp;
layer2-policer {
    input-policer policer-name;
    input-three-color policer-name;
    output-policer policer-name;
    output-three-color policer-name;
}
link-layer-overhead percent;
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
    up-count cells;
    down-count cells;
}
oam-period (seconds | disable);
output-vlan-map {
    inner-tag-protocol-id;
    inner-vlan-id;
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-swap);
    tag-protocol-id tpid;
    vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
    chap {
        access-profile name;
        default-chap-secret name;
        local-name name;
        passive;
    }
    compression {

```

```

    acfc;
    pfc;
  }
}
dynamic-profile profile-name;
pap {
  default-pap-password password;
  local-name name;
  local-password password;
  passive;
}
}
proxy-arp;
service-domain (inside | outside);
shaping {
  (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
  burst length);
  queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
  backup-destination address;
  destination address;
  key number;
  routing-instance {
    destination routing-instance-name;
  }
  source source-address;
  ttl number;
}
vci vpi-identifier.vci-identifier;
vlan-id number;
vlan-id-list [vlan-id vlan-id-vlan-id]
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
vlan-tags outer tpid.vlan-id inner-list [vlan-id vlan-id-vlan-id]
vpi vpi-identifier;
family family {
  accounting {
    destination-class-usage;
    source-class-usage {
      direction;
    }
  }
}
bundle interface-name;
filter {
  group filter-group-number;
  input filter-name;
  input-list {
    [ filter-names ];
  }
  output filter-name;
  output-list {

```

```

    [ filter-names ];
}
}
ipsec-sa sa-name;
keep-address-and-control;
mtu bytes;
multicast-only;
no-redirects;
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
proxy inet-address address;
receive-options-packets;
receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check <fail-filter filter-name> {
    <mode loose>;
}
sampling {
    direction;
}
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-name <service-filter filter-name>;
    }
}
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
unnumbered-address interface-name destination address destination-profile
    profile-name;
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    multipoint-destination address (dlci dlci-identifier | vci vci-identifier);
    multipoint-destination address {
        epd-threshold cells plp1 cells;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (seconds | disable);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
            queue-length number;

```

```

    }
    vci vpi-identifier.vci-identifier;
  }
  preferred;
  primary;
  (vrrp-group | vrrp-inet6-group) group-number {
    (accept-data | no-accept-data);
    advertise-interval seconds;
    authentication-type authentication;
    authentication-key key;
    fast-interval milliseconds;
    (preempt | no-preempt) {
      hold-time seconds;
    }
    priority-number number;
    track {
      priority-cost seconds;
      priority-hold-time interface-name {
        interface priority;
        bandwidth-threshold bits-per-second {
          priority;
        }
      }
    }
    route ip-address/mask routing-instance instance-name priority-cost cost;
  }
}
virtual-address [ addresses ];
}
}
}
}
}

```

#### Related Documentation

- [Junos OS Hierarchy and RFC Reference](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Junos OS Network Interfaces Library for Routing Devices](#)

## [edit protocols authentication-access-control] Configuration Statement Hierarchy on MX Series Routers

This topic lists supported and unsupported configuration statements in the **[edit protocols authentication-access-control]** hierarchy level on MX240, MX480, and MX960 routers when they operate in enhanced LAN mode.

- *Supported* statements are those that you can use to configure some aspect of a software feature on the switch.
- *Unsupported* statements are those that appear in the command-line interface (CLI) on the switch, but that have no effect on switch operation if you configure them.

This topic lists:

- [Supported Statements in the \[edit protocols authentication-access-control\] Hierarchy Level on page 844](#)
- [Unsupported Statements in the \[edit protocols authentication-access-control\] Hierarchy Level on page 845](#)

## Supported Statements in the [edit protocols authentication-access-control] Hierarchy Level

The following hierarchy shows the **[edit protocols authentication-access-control]** configuration statements supported on MX Series routers:

```
protocols {
  authentication-access-control {
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>
        <match regex>;
      flag flag ;
    }
    uac-policy;
    authentication-profile-name access-profile-name;
    no-mac-table-binding {
      interface interface-names
        static mac-address
      }
    static mac-address {
      interface interface-names;
      vlan-assignment (vlan-id | vlan-name);
    }
    interface (all | [ interface-names ]) {
      session-expiry seconds;
      quiet-period seconds;
      reauthentication {
        interval seconds;
      }
      retries number;
      server-timeout seconds;
      supplicant (single | single-secure | multiple);
      dot1x {
        disable;
        guest-vlan (vlan-id | vlan-name);
        mac-radius {
          flap-on-disconnect;
          restrict;
        }
        maximum-requests number;
        no-reauthentication;
        server-fail (deny | permit | use-cache | vlan-id | vlan-name);
        server-reject-vlan (vlan-id | vlan-name) {
          eapol-block;
          block-interval block-interval;
        }
        supplicant-timeout seconds;
        transmit-period seconds;
      }
    }
  }
}
```



```

    }
  }
  (captive-portal | no-captive-portal);
}
captive-portal-custom-options {
  banner-message string;
  footer-bgcolor color;
  footer-message string;
  footer-text-color color;
  form-header-bgcolor color;
  form-header-message string;
  form-header-text-color color;
  form-reset-label label name;
  form-submit-label label name;
  header-bgcolor color;
  header-logo filename;
  header-message string;
  header-text-color color;
  post-authentication-url url-string;
  secure-authentication (http | https);
}
}

```

## Unsupported Statements in the [edit protocols authentication-access-control] Hierarchy Level

All statements in the [edit protocols authentication-access-control] hierarchy level that are displayed in the command-line interface (CLI) on the switch are supported on the switch and operate as documented.

## [edit protocols connections] Hierarchy Level

The following statements can also be configured at the [edit logical-systems *logical-system-name* protocols connections] hierarchy level.

```

interface-switch connection-name {
  interface interface-name.unit-number;
  interface interface-name.unit-number;
}

```

- Related Documentation**
- [Junos OS Hierarchy and RFC Reference](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)
  - [Junos OS Network Interfaces Library for Routing Devices](#)

---

## [edit protocols dot1x] Hierarchy Level

```
dot1x {  
  authenticator  
    authentication-profile-name access-profile-name;  
    interface interface-ids {  
      maximum-requests integer;  
      retries integer;  
      quiet-period seconds;  
      transmit-period seconds;  
      reauthentication (disable | interval seconds);  
      server-timeout seconds;  
      supplicant (single);  
      supplicant-timeout seconds;  
    }  
  }  
}
```

- Related Documentation**
- [Junos OS Hierarchy and RFC Reference](#)
  - [Ethernet Interfaces Feature Guide for Routing Devices](#)
  - [Junos OS Network Interfaces Library for Routing Devices](#)

---

## [edit protocols iccp] Hierarchy Level

The following statement hierarchy can also be included at the [edit logical-systems *logical-system-name*] hierarchy level.

```
iccp {  
  traceoptions;  
  local-ip-address ip address;  
  session-establishment-hold-time value;  
  authentication-key string;  
  peer ip-address {  
    local-ip-address ip address;  
    session-establishment-hold-time value;  
    authentication-key string;  
    redundancy-group-id-list redundancy-group-id-list;  
    liveness-detection;  
  }  
}
```

- Related Documentation**
- [iccp on page 988](#)
  - [Configuring ICCP for MC-LAG](#)

## [edit protocols lacp] Hierarchy Level

```
ppm (Ethernet Switching)
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <disable>;
  }
fast-hello-issu
```

- Related Documentation**
- *Junos OS Hierarchy and RFC Reference*
  - *Ethernet Interfaces Feature Guide for Routing Devices*
  - [Configuring Distributed Periodic Packet Management on page 202](#)
  - *Junos OS Network Interfaces Library for Routing Devices*

## [edit protocols lldp] Hierarchy Level

```
protocols {
  lldp {
    disable;
    advertisement-interval seconds;
    hold-multiplier seconds;
    interface (all | interface-name) {
      disable;
    }
    lldp-configuration-notification-interval seconds;
    ptopo-configuration-maximum-hold-time seconds;
    ptopo-configuration-trap-interval seconds;
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <disable>;
    }
    transmit-delay seconds;
  }
}
```

- Related Documentation**
- *Notational Conventions Used in Junos OS Configuration Hierarchies*
  - [\[edit protocols\] Hierarchy Level](#)

## [edit protocols oam] Hierarchy Level

```
ethernet {
  connectivity-fault-management {
    action-profile profile-name {
      default-actions {
        interface-down;
      }
    }
    event {
      adjacency-loss;
    }
  }
}
```

```

    interface-status-tlv (down | lower-layer-down);
    port-status-tlv blocked;
    rdi;
  }
}
linktrace {
  age (30m | 10m | 1m | 30s | 10s);
  path-database-size path-database-size;
}
maintenance-domain domain-name {
  bridge-domain name;
  routing-instance r1 {
    bridge-domain name;
    instance vpls-instance;
    interface (ge | xe) fpc/pic/port.domain;
    level number;
    maintenance-association name {
      mep identifier {
        direction (up | down)
        interface (ge | xe) fpc/pic/port.domain (working | protect );
        auto-discovery;
        lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect |
          rem-err-xcon | xcon);
        priority number;
      }
    }
  }
  mip-half-function (none | default | explicit);
  name-format (character-string | none | dns | mac+2oct);
  short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
  protect-maintenance-association protect-ma-name;
  remote-maintenance-association remote-ma-name;
  continuity-check {
    hold-interval minutes;
    interval (10m | 10s | 1m | 1s | 100ms);
    loss-threshold number;
  }
  maintenance-association ma-name {
    mip-half-function (none | default | explicit);
    mep mep-id {
      auto-discovery;
      direction (up | down);
      interface interface-name (working | protect);
      priority number;
      remote-mep mep-id {
        action-profile profile-name;
        sla-iterator-profile profile-name {
          data-tlv-size bytes;
          iteration-count frames;
          priority priority-value;
        }
      }
    }
  }
}
}
performance-monitoring {
  hardware-assisted-timestamping;
}

```

```

sla-iterator-profiles {
  profile-name {
    disable;
    calculation-weight {
      delay delay-weight;
      delay-variation delay-variation-weight;
    }
    cycle-time milliseconds;
    iteration-period connections;
    measurement-type (loss | statistical-frame-loss | two-way-delay);
  }
}
no-aggregate-delegate-processing;
}
link-fault-management {
  action-profile profile-name {
    action {
      syslog;
      link-down;
      send-critical-event;
    }
    event {
      link-adjacency-loss;
      link-event-rate {
        frame-error count;
        frame-period count;
        frame-period-summary count;
        symbol-period count;
      }
      protocol-down;
    }
  }
}
interface interface-name {
  apply-action-profile profile-name;
  event-thresholds {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
  }
  link-discovery (active | passive);
  negotiation-options {
    allow-remote-loopback;
    no-allow-link-events;
  }
  pdu-interval interval;
  pdu-threshold threshold-value;
  remote-loopback;
}
}
fnp {
  interval <100ms | 1s | 10s | 1m | 10m>;
  loss-threshold number
  interface interface name {
    domain-id domain-id

```

$$\left. \begin{array}{l} \{ \\ \{ \\ \{ \end{array} \right\}$$

## Related Documentation

- *Junos OS Hierarchy and RFC Reference*
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Junos OS Network Interfaces Library for Routing Devices*

## [edit protocols ppp] Hierarchy Level

```
monitor-session (interface-name | all);
traceoptions {
    file filename <files number> <match regular-expression> <size size> <world-readable |
        no-world-readable> ;
    flag flag <disable>;
}
```

## Related Documentation

- *Junos OS Hierarchy and RFC Reference*
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Junos OS Network Interfaces Library for Routing Devices*

## [edit protocols pppoe] Hierarchy Level

```
ppoe {  
    no-send-pads-error;  
    no-send-pads-ac-info  
    pado-advertise;  
    service-name-tables table-name {  
        service service-name {  
            drop;  
            delay seconds;  
            terminate;  
            dynamic-profile profile-name;  
            routing-instance routing-instance-name;  
            max-sessions number;  
            agent-specifier {  
                aci circuit-id-string ari remote-id-string {  
                    drop;  
                    delay seconds;  
                    terminate;  
                    dynamic-profile profile-name;  
                    routing-instance routing-instance-name;  
                    static-interface interface-name;  
                }  
            }  
        }  
    }  
}  
  
traceoptions {  
    file <filename> <files number> <match regular-expression> <size maximum-file-size>  
    <world-readable | no-world-readable>;  
}
```

```

filter {
    aci regular-expression;
    ari regular-expression;
    service-name regular-expression;
    underlying-interface interface-name;
}
flag flag;
level (all | error | info | notice | verbose | warning);
no-remote-trace;
}
}

```

## [edit protocols protection-group] Hierarchy Level

```

ethernet-ring ring-name {
    east-interface {
        control-channel channel-name {
            vlan number;
        }
    }
    guard-interval number;
    node-id mac-address;
    restore-interval number;
    ring-protection-link-owner;
    west-interface {
        control-channel channel-name {
            vlan number;
        }
    }
}
}

```

### Related Documentation

- [Junos OS Hierarchy and RFC Reference](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
- [Junos OS Network Interfaces Library for Routing Devices](#)

## [edit protocols vrrp] Hierarchy Level

The following statement hierarchy can also be included at the [edit logical-systems *logical-system-name*] hierarchy level.

```

protocols {
    vrrp {
        asymmetric-hold-time;
        delegate-processing;
        failover-delay milliseconds;
        global-advertisements-threshold advertisement-value;
        skew-timer-disable;
        startup-silent-period seconds;
        traceoptions {
            file <filename> <files number> <match regular-expression> <microsecond-stamp>
              <size maximum-file-size> <world-readable | no-world-readable>;
            flag flag;
        }
    }
}

```

```
no-remote-trace;
}
version-3;
}
}
```

**Related  
Documentation**

- *Notational Conventions Used in Junos OS Configuration Hierarchies*
- *[edit protocols] Hierarchy Level*
- *Junos OS Hierarchy and RFC Reference*
- *Ethernet Interfaces Feature Guide for Routing Devices*
- *Junos OS Network Interfaces Library for Routing Devices*

## [edit security macsec] Configuration Statement Hierarchy on MX Series Routers

This topic lists supported and unsupported configuration statements in the **[edit security macsec]** hierarchy level on MX240, MX480, and MX960 routers in both non-enhanced LAN mode and enhanced LAN mode.

- *Supported* statements are those that you can use to configure some aspect of a software feature on the router.
- *Unsupported* statements are those that appear in the command-line interface (CLI) on the router, but that have no effect on router operation if you configure them.

This topic lists:

- [Supported Statements in the \[edit security macsec\] Hierarchy Level on page 852](#)
- [Unsupported Statements in the \[edit security macsec\] Hierarchy Level on page 853](#)

## Supported Statements in the [edit security macsec] Hierarchy Level

The following hierarchy shows the **[edit security macsec]** configuration statements supported on MX Series routers:

```
security {
  macsec {
    connectivity-association connectivity-association-name {
      exclude-protocol protocol-name;
      include-sci;
      mka {
        must-secure;
        key-server-priority priority-number;
        transmit-interval interval;
      }
      no-encryption;
      offset (0|30|50);
      pre-shared-key {
        cak hexadecimal-number;
        ckn hexadecimal-number;
      }
      replay-protect{
```



```

        replay-window-size number-of-packets;
    }
    secure-channel secure-channel-name {
        direction (inbound | outbound);
        encryption ;
        id {
            mac-address mac-address;
            port-id port-id-number;
        }
        offset (0|30|50);
        security-association security-association-number {
            key key-string;
        }
    }
    security-mode security-mode;
}
interfaces interface-name {
    connectivity-association connectivity-association-name;
}
}
}

```

### Unsupported Statements in the [edit security macsec] Hierarchy Level

All statements in the [edit security macsec] hierarchy level that are displayed in the command-line interface (CLI) on the router are supported on the router and operate as documented.

**Related Documentation**

- *Notational Conventions Used in Junos OS Configuration Hierarchies*

### [edit system processes] Hierarchy Level

```

    dialer-services {
        disable;
    }
    isdn-signaling {
        disable;
        reject-incoming;
    }
}

```

**Related Documentation**



- *ISDN Configuration Overview*
- *Disabling ISDN Processes*

## 802.3ad

---

|                          |                                                                                                                                                                                                                                                                                                                              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>802.3ad {<br/>    ae <i>interface-number</i> (primary   backup);<br/>    lacp {<br/>        port-priority;<br/>    }<br/>}</pre>                                                                                                                                                                                        |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> <a href="#">fastether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ]                                                                                                                                                                     |
| Release Information      | Statement introduced before Junos OS Release 7.4.<br><b>primary</b> and <b>backup</b> options added in Junos OS Release 8.3.                                                                                                                                                                                                 |
| Description              | Specify aggregated Ethernet logical interface number.                                                                                                                                                                                                                                                                        |
| Options                  | <b>ae <i>interface-number</i></b> —Aggregated Ethernet logical interface number.<br><b>Range:</b> 0 through 15<br><br><b>primary</b> —For link protection configurations, specify the primary link for egress traffic.<br><br><b>backup</b> —For link protection configurations, specify the backup link for egress traffic. |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                      |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Aggregated Ethernet Interface on page 126</a></li><li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li></ul>                                                                                                             |

## accept-source-mac

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> accept-source-mac {     mac-address mac-address {         policer {             input cos-policer-name;             output cos-policer-name;         }     } } </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | <p>[edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i>],<br/> [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i>]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.<br/> Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.<br/> Statement introduced in Junos OS Release 13.2 for the QFX Series.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>For Gigabit Ethernet intelligent queuing (IQ) interfaces only, accept traffic from and to the specified remote media access control (MAC) address.</p> <p>The <b>accept-source-mac</b> statement is equivalent to the <b>source-address-filter</b> statement, which is valid for aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only. To allow the interface to receive packets from specific MAC addresses, include the <b>accept-source-mac</b> statement.</p> <p>On untagged Gigabit Ethernet interfaces, you should not configure the <b>source-address-filter</b> statement and the <b>accept-source-mac</b> statement simultaneously. On tagged Gigabit Ethernet interfaces, you should not configure the <b>source-address-filter</b> statement and the <b>accept-source-mac</b> statement with an identical MAC address specified in both filters.</p> <p>The statements are explained separately.</p> |
|                                 | <p> <b>NOTE:</b> The <b>policer</b> statement is not supported on PTX Series Packet Transport Routers.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                 | <p> <b>NOTE:</b> On QFX platforms, if you configure source MAC addresses for an interface using the <i>static-mac</i> or <i>persistent-learning</i> statements and later configure a different MAC address for the same interface using the <b>accept-source-mac</b> statement, the MAC addresses that you previously configured for the interface remain in the ethernet-switching table and can still be used to send packets to the interface.</p>                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.<br/> interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

- Related Documentation**
- [Configuring MAC Address Filtering on page 465](#)
  - [Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15](#)
  - [source-filtering on page 1181](#)

## access-concentrator

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>access-concentrator <i>name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>     | <p>[edit dynamic-profiles <i>profile-name</i> interfaces demux0 unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit dynamic-profiles <i>profile-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>family</b> pppoe],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-options</b>],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-underlying-options</b>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>family</b> pppoe],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-options</b>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-underlying-options</b>]</p> |
| <b>Release Information</b> | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Support at the [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-underlying-options</b>] and [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-underlying-options</b>] hierarchy levels introduced in Junos OS Release 10.1.</p> <p>Support at the [edit ... <b>family pppoe</b>] hierarchies introduced in Junos OS Release 11.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>         | Configure an alternative access concentrator name in the AC-NAME tag in a PPPoE control packet for use with a dynamic PPPoE subscriber interface. If you do not configure the access concentrator name, the AC-NAME tag contains the system name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



**NOTE:** The [edit ... **family pppoe**] hierarchies are supported only on MX Series routers with MPCs.

|                                 |                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Options</b>                  | <i>name</i> —Name of the access concentrator.                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Identifying the Access Concentrator on page 331</a></li> <li>• <a href="#">Configuring the PPPoE Family for an Underlying Interface</a></li> <li>• <a href="#">Configuring Dynamic PPPoE Subscriber Interfaces</a></li> <li>• <a href="#">PPPoE Overview on page 328</a></li> </ul> |

## account-layer2-overhead (PIC Level)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | account-layer2-overhead;                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit chassis fpc <i>slot-number</i> pic <i>pic-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | Enable the automatic adjustment of Layer 2 overhead in bytes, which is the octet adjustment per packet, based on the encapsulation on the logical interface for the total octet count for ingress and egress traffic on all the interfaces in the PIC.                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 459</a></li> <li>• <a href="#">Configuring Layer 2 Overhead Accounting in Interface Statistics on page 461</a></li> <li>• <a href="#">Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 462</a></li> <li>• <a href="#">[edit chassis] Hierarchy Level on page 821</a></li> </ul> |

## action (OAM)

|                                 |                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> action {   link-down;   send-critical-event;   syslog; } </pre>                                                                               |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">link-fault-management</a> <a href="#">action-profile</a> ]                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                       |
| <b>Description</b>              | Define the action or actions to be taken when the OAM fault event occurs.                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying the Actions to Be Taken for Link-Fault Management Events on page 605</a></li> </ul> |

## action-profile (Applying to CFM)

---

|                                 |                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>action-profile <i>profile-name</i>;</code>                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> mep <i>mep-id</i> <a href="#">remote-mep</a> <i>mep-id</i> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                        |
| <b>Description</b>              | Identify the action profile to use.                                                                                                                                                                  |
| <b>Options</b>                  | <i>profile-name</i> —Name of the action profile to use.                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li></ul>                                                     |

## action-profile (Defining for CFM)

```
Syntax  action-profile profile-name {
        event {
            ais-trigger-condition {
                adjacency-loss;
                all-defects;
                cross-connect-ccm;
                erroneous-ccm;
                receive-ais;
            }
            interface-status-tlv (down | lower-layer-down);
            port-status-tlv blocked;
            rdi;
        }
        action {
            interface-down;
            log-and-generate-ais {
                interval(1m | 1s);
                level value;
                priority value;
            }
        }
        default-actions {
            interface-down;
        }
    }
```

**Hierarchy Level** [edit protocols oam ethernet [connectivity-fault-management](#)]

**Release Information** Statement introduced in Junos OS Release 8.4.

**Description** Configure a name and default action for an action profile.

**Options** *profile-name*—Name of the action profile.

The remaining statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538](#)
- [default-actions on page 921](#)
- [event \(CFM\)](#)
- [interface-down on page 1006](#)

## action-profile (Defining for LFM)

---

**Syntax**    `action-profile profile-name {  
              action {  
                  link-down;  
                  send-critical-event;  
                  syslog;  
              }  
              event {  
                  link-adjacency-loss;  
                  link-event-rate {  
                      frame-error count;  
                      frame-period count;  
                      frame-period-summary count;  
                      symbol-period count;  
                  }  
                  protocol-down;  
              }  
          }`

**Hierarchy Level**    [edit protocols [oam ethernet link-fault-management](#)]

**Release Information**    Statement introduced in Junos OS Release 8.5.

**Description**    Configure a name, one or more actions, and the events that trigger the action for an action profile.

**Options**    *profile-name*—Name of the action profile.

The remaining statements are explained separately.

**Required Privilege Level**    interface—To view this statement in the configuration.  
                                  interface-control—To add this statement to the configuration.

**Related Documentation**    • [Configuring an OAM Action Profile on page 603](#)



## action-profile (MEP)

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>action-profile <i>action-profile-name</i>;</code>                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>md-name</i><br>maintenance-association <i>ma-name</i> mep <i>mep-id</i> ]                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                    |
| <b>Description</b>              | Attach the configured action profile to the MEP depending on the hierarchy level.                                                                                                                                 |
| <b>Options</b>                  | <b><i>action-profile-name</i></b> —Name of the action profile that is configured for the CFM MEP and the server MEP.                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul> |

## adaptive

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>adaptive {<br/>  pps;<br/>  scan-interval <i>multiple</i>;<br/>  tolerance <i>tolerance-percentage</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces aex aggregated-ether-options load-balance]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R3 for MX Series Routers.<br>Statement introduced in Junos OS Release 14.1 for PTX Series Packet Transport Routers.<br>Statement introduced in Junos OS Release 15.1X53-D10 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | Correct a genuine traffic imbalance by using a feedback mechanism to distribute the traffic across the links of an aggregated Ethernet bundle.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><b>pps</b>—(PTX Series only) The type of traffic rate among the members of the AE bundle is measured packets per second. The default rate type is bytes per second.</p> <p><b>scan-interval <i>multiple</i></b>—(PTX Series only) Scan interval, as a multiple of a 30-second interval.<br/><b>Range:</b> 1 through 5<br/><b>Default:</b> 1</p> <p><b>tolerance <i>tolerance-percentage</i></b>—(MX Series and PTX Series) Limit to the variance in the packet traffic flow to the aggregated Ethernet links in a percentage.<br/><b>Range:</b> 1 through 100 percent<br/><b>Default:</b> 20 percent</p> |
| <b>Required Privilege Level</b> | interface - To view this statement in the configuration.<br>interface-control - To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Understanding Aggregated Ethernet Load Balancing on page 166</a></li><li>• <a href="#">Example: Configuring Aggregated Ethernet Load Balancing on page 171</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                |

## address

```

Syntax  address address {
        arp ip-address (mac | multicast-mac) mac-address <publish>;
        broadcast address;
        destination address;
        destination-profile name;
        eui-64;
        master-only;
        multipoint-destination address dlcid dlcid-identifier;
        multipoint-destination address {
            epd-threshold cells;
            inverse-arp;
            oam-liveness {
                up-count cells;
                down-count cells;
            }
            oam-period (disable | seconds);
            shaping {
                (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate burst
                 length);
                queue-length number;
            }
            vci vpi-identifier.vci-identifier;
        }
        primary;
        preferred;
        (vrrp-group | vrrp-inet6-group) group-number {
            (accept-data | no-accept-data);
            advertise-interval seconds;
            authentication-type authentication;
            authentication-key key;
            fast-interval milliseconds;
            (preempt | no-preempt) {
                hold-time seconds;
            }
            priority-number number;
            track {
                priority-cost seconds;
                priority-hold-time interface-name {
                    interface priority;
                    bandwidth-threshold bits-per-second {
                        priority;
                    }
                }
            }
            route ip-address/mask routing-instance instance-name priority-cost cost;
        }
        virtual-address [ addresses ];
    }
}

```

**Hierarchy Level** [edit interfaces *interface-name* unit *logical-unit-number* family *family*],  
 [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*  
 family *family*]

**Release Information** Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 11.1 for the QFX Series.  
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

**Description** Configure the interface address.



**NOTE:** The vrrp High Availability functionality is not available on the QFX Series.

**Options** *address*—Address of the interface.

- In Junos OS Release 13.3 and later, when you configure an IPv6 host address and an IPv6 subnet address on an interface, the commit operation fails.
- In releases earlier than Junos OS Release 13.3, when you use the same configuration on an interface, the commit operation succeeds, but only one of the IPv6 addresses that was entered is assigned to the interface. The other address is not applied.



**NOTE:** If you configure the same address on multiple interfaces in the same routing instance, Junos OS uses only the first configuration. The remaining address configurations are ignored and can leave interfaces without an address. Interfaces that do not have an assigned address cannot be used as a donor interface for an unnumbered Ethernet interface.

For example, in the following configuration the address configuration of interface xe-0/0/1.0 is ignored:

```
interfaces {
  xe-0/0/0 {
    unit 0 {
      family inet {
        address 192.168.1.1/24;
      }
    }
  }
  xe-0/0/1 {
    unit 0 {
      family inet {
        address 192.168.1.1/24;
      }
    }
  }
}
```

For more information on configuring the same address on multiple interfaces, see *Configuring the Interface Address*.

The remaining statements are explained separately.



**NOTE:** The `edit logical-systems` hierarchy is not available on QFabric systems.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

- |                              |                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <i>Configuring the Protocol Family</i></li><li>• <i>Junos OS Administration Library for Routing Devices</i></li><li>• <i>family</i></li><li>• <a href="#">negotiate-address on page 1078</a></li><li>• <i>unnumbered-address (Ethernet)</i></li><li>• <i>Junos OS Administration Library for Routing Devices</i></li></ul> |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

---

## adjacency-loss

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | adjacency-loss;                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> event ais-trigger-condition]                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                    |
| <b>Description</b>              | Configure the defect condition that raises an alarm indication signal when physical connectivity is lost between peer MEPs.                                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul> |

## advertisement-interval

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>advertisement-interval seconds;</code>                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ]                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6 for MX Series and T Series routers.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 14.1X53-D20 for OCX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.<br>Statement introduced in Junos OS Release 14.1X53-D20 for OCX Series switches. |
| <b>Description</b>              | (MX Series and T Series routers only) Configure an interval for LLDP advertisement.                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <b>seconds</b> —Interval between LLDP advertisement.<br><b>Default:</b> 30<br><b>Range:</b> 5 through 32768                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring LLDP on page 316</a></li> <li>• <code>show lldp</code></li> <li>• <i>Configuring LLDP (CLI Procedure)</i></li> <li>• <i>Understanding LLDP and LLDP-MED on EX Series Switches</i></li> <li>• <i>transmit-delay</i></li> <li>• <i>Understanding LLDP</i></li> </ul>                                                             |

## age

---

|                                 |                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | age (30m   10m   1m   30s   10s);                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management linktrace</a> ]                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                           |
| <b>Description</b>              | Time to wait (in minutes or seconds) for a response. If no response is received, the request and response entry is deleted from the linktrace database. |
| <b>Default</b>                  | 10 minutes                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Linktrace Protocol in CFM on page 539</a></li></ul>                                     |



## agent-specifier

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre> agent-specifier {     aci <i>circuit-id-string</i> ari <i>remote-id-string</i> {         drop;         delay <i>seconds</i>;         terminate;         dynamic-profile <i>profile-name</i>;         routing-instance <i>routing-instance-name</i>;         static-interface <i>interface-name</i>;     } } </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>     | [edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b> | <p>Statement introduced in Junos OS Release 10.0.</p> <p><b>drop</b>, <b>delay</b>, <b>terminate</b>, <b>dynamic-profile</b>, <b>routing-instance</b>, and <b>static-interface</b> options introduced in Junos OS Release 10.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>         | <p>Specify the action taken by the interface for the specified agent circuit identifier/agent remote identifier (ACI/ARI) pair when the interface receives a PPPoE Active Discovery Initiation (PADI) control packet that includes the vendor-specific tag with ACI/ARI pair information. You can configure an ACI/ARI pair for a named service, <b>empty</b> service, or <b>any</b> service in a PPPoE service name table. A maximum of 8000 ACI/ARI pairs are supported per PPPoE service name table. You can distribute the ACI/ARI pairs in any combination among the named, <b>empty</b>, and <b>any</b> service entries in the service name table.</p> <p>You can use an asterisk (*) as a wildcard character to match ACI/ARI pairs, the ACI alone, or the ARI alone. The asterisk can be placed only at the beginning, the end, or both the beginning and end of the identifier string. You can also specify an asterisk alone for either the ACI or the ARI. You cannot specify only an asterisk for both the ACI and the ARI. When you specify a single asterisk as the identifier, that identifier is ignored in the PADI packet.</p> <p>For example, suppose you care about matching only the ACI and do not care what value the ARI has in the PADI packet, or even whether the packet contains an ARI value. In this case you can set the <b>remote-id-string</b> to a single asterisk. Then the interface ignores the ARI received in the packet and the interface takes action based only on matching the specified ACI.</p> |
| <b>Default</b>             | The default action is terminate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>             | <p><b>aci <i>circuit-id-string</i></b>—Identifier for the agent circuit ID that corresponds to the DSLAM interface that initiated the service request. This is a string of up to 63 characters.</p> <p><b>ari <i>remote-id-string</i></b>—Identifier for the subscriber associated with the DSLAM interface that initiated the service request. This is a string of up to 63 characters.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                 |                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring PPPoE Service Name Tables</i></li><li>• <i>Assigning an ACI/ARI Pair to a Service Name and Configuring the Action Taken When the Client Request Includes ACI/ARI Information</i></li></ul> |

---

## aggregate (Gigabit Ethernet CoS Policer)

---

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>aggregate {<br/>    bandwidth-limit <i>bps</i>;<br/>    burst-size-limit <i>bytes</i>;<br/>}</pre>                                                                                                              |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">policer</a> <i>cos-policer-name</i> ]                           |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                    |
| <b>Description</b>              | Define a policer to apply to nonpremium traffic.<br><br>The statements are explained separately.                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li><li>• <i>premium (Hierarchical Policer)</i></li><li>• <a href="#">ieee802.1p on page 989</a></li></ul> |

## aggregated-devices

|                                 |                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> aggregated-devices {   ethernet {     device-count <i>number</i>;     lacp {       link-protection {         non-revertive;       }       system-priority;     }   }   sonet {     device-count <i>number</i>;   }   maximum-links <i>maximum-links-limit</i>; } </pre> |
| <b>Hierarchy Level</b>          | [edit chassis]                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Support for LACP link protection and system priority introduced in Junos OS Release 9.3.                                                                                                                                 |
| <b>Description</b>              | Configure properties for aggregated devices on the router.                                                                                                                                                                                                                    |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Junos OS for Supporting Aggregated Devices on page 140</a></li> </ul>                                                                                                                                        |

## aggregated-ether-options

```
Syntax aggregated-ether-options {
    ethernet-switch-profile {
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit bps;
                    burst-size-limit bytes;
                }
                premium {
                    bandwidth-limit bps;
                    burst-size-limit bytes;
                }
            }
        }
        (mac-learn-enable | no-mac-learn-enable);
    }
    (flow-control | no-flow-control);
    lacp {
        (active | passive);
        link-protection {
            disable;
            (revertive | non-revertive);
            periodic interval;
            system-priority priority;
            system-id system-id;
        }
    }
    link-protection;
    load-balance;
    link-speed speed;
    logical-interface-chassis-redundancy;
    logical-interface-fpc-redundancy;
    (loopback | no-loopback);
    minimum-links number;
    rebalance-periodic time hour:minute <interval hours>;
    source-address-filter {
        mac-address;
        (source-filtering | no-source-filtering);
    }
}
```

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Hierarchy Level</b>          | [edit interfaces aex]                                                                                                   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                       |
| <b>Description</b>              | Configure aggregated Ethernet-specific interface properties.<br><br>The statements are explained separately.            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Interfaces Overview on page 3</a></li> </ul>              |

## ais-trigger-condition

---

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>ais-trigger-condition {   adjacency-loss;   all-defects;   cross-connect-ccm;   erroneous-ccm;   receive-ais; }</pre>                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> event]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                       |
| <b>Description</b>              | Configure the defect conditions that generate an alarm indication signal (AIS).                                                                                                                                      |
| <b>Options</b>                  | The statements are explained separately.                                                                                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li> <li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li> </ul> |

## alarm (optics-options)

---

|                                 |                                                                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | alarm low-light-alarm {<br>(link-down   syslog);<br>}                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>optics-options</b> ]                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                |
| <b>Description</b>              | Specify the action to take if the receiving optics signal is below the optics low-light alarm threshold.                                                                                                                                                               |
| <b>Options</b>                  | <b>link-down</b> —Drop the 10-Gigabit Ethernet link and marks link as down.<br><br><b>syslog</b> —Write the optics information to the system log.                                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 390</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li></ul> |

## alarms

---

|                                 |                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | alarms;                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>optics-options</b> ]                                                                     |
| <b>Release Information</b>      | Statement introduced in JUNOS Release 10.1.                                                                                        |
| <b>Description</b>              | For 10-Gigabit Ethernet DPCs, configure the DPC to drop the interface link when the receive power falls below the alarm threshold. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet DWDM Interface Wavelength Overview on page 381</a></li></ul>          |

## all-defects

---

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | all-defects;                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> event ais-trigger-condition]                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                       |
| <b>Description</b>              | Configure the defect condition that raises an alarm indication signal when any or all possible defects occur in the maintenance domain level.                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li> <li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li> </ul> |

## allow-remote-loopback

---

|                                 |                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | allow-remote-loopback;                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam link-fault-management interface</a> <i>interface-name</i> <a href="#">negotiation-options</a> ]                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                     |
| <b>Description</b>              | Enable the remote loopback on IQ2 and IQ2-E Gigabit Ethernet interfaces, and Ethernet interfaces on the MX Series routers and EX Series switches. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Enabling Remote Loopback Support on the Local Interface on page 611</a></li> </ul>           |

## apply-action-profile

---

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>apply-action-profile <i>profile-name</i>;</code>                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management interface</a> ]                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                           |
| <b>Description</b>              | Apply the specified action profile to the interface for link-fault management.                                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Applying an Action Profile on page 609</a></li></ul>                |



## arp (Interfaces)

|                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                         | <code>arp <i>ip-address</i> (mac   multicast-mac) <i>mac-address</i> publish;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>                                                                                                                                                                | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet address <i>address</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet address <i>address</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>                                                                                                                                                            | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>                                                                                                                                                                    | For Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only, configure Address Resolution Protocol (ARP) table entries, mapping IP addresses to MAC addresses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                                                                                                                                                                        | <p><b><i>ip-address</i></b>—IP address to map to the MAC address. The IP address specified must be part of the subnet defined in the enclosing <b>address</b> statement.</p> <p><b>mac <i>mac-address</i></b>—MAC address to map to the IP address. Specify the MAC address as six hexadecimal bytes in one of the following formats: <i>nnnn.nnnn.nnnn</i> or <i>nn:nn:nn:nn:nn:nn</i>. For example, <b>0011.2233.4455</b> or <b>00:11:22:33:44:55</b>.</p> <p><b>multicast-mac <i>mac-address</i></b>—Multicast MAC address to map to the IP address. Specify the multicast MAC address as six hexadecimal bytes in one of the following formats: <i>nnnn.nnnn.nnnn</i> or <i>nn:nn:nn:nn:nn:nn</i>. For example, <b>0011.2233.4455</b> or <b>00:11:22:33:44:55</b>.</p> <p><b>publish</b>—(Optional) Have the router or switch reply to ARP requests for the specified IP address. If you omit this option, the router or switch uses the entry to reach the destination but does not reply to ARP requests.</p> |
| <div>  <b>NOTE:</b> The edit logical-systems hierarchy is not available on QFabric systems. </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b>                                                                                                                                                       | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>                                                                                                                                                          | <ul style="list-style-type: none"> <li><a href="#">Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses on page 348</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## asynchronous-notification

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (asynchronous-notification   no-asynchronous-notification);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>ge-fpc/pic/port</i> gigether-options ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.3.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | <p>For all 10-Gigabit Ethernet interfaces, M120, M320, and T Series routers, configure support for notification of link down alarm generation and transfer.</p> <p>(MX Series routers, T Series routers) For all Gigabit Ethernet interfaces (1-Gigabit, 10-Gigabit, and 100-Gigabit), configure support for notification of link down alarm generation and transfer.</p> <p>(M120 and M320 routers) For all 10-Gigabit Ethernet PIC interfaces, configure support for notification of link down alarm generation and transfer.</p> <ul style="list-style-type: none"><li>• <b>asynchronous-notification</b>—Support notification of link down alarm generation and transfer.</li><li>• <b>no-asynchronous-notification</b>—Prohibit notification of link down alarm generation and transfer.</li></ul> |
| <b>Default</b>                  | Support for notification of link down alarm generation and transfer is not enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Gigabit Ethernet Notification of Link Down Alarm Overview on page 389</a></li><li>• <a href="#">Configuring Gigabit Ethernet Notification of Link Down Alarm on page 390</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## authentication-access-control (MX Series in Enhanced LAN Mode)

```
Syntax authentication-access-control {
    traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable> <match
            regex>;
        flag flag;
    }
    uac-policy;
    authentication-profile-name access-profile-name;
    no-mac-table-binding {
        interface interface-names
        static mac-address
    }
    static mac-address {
        interface interface-names;
        vlan-assignment (vlan-id | vlan-name);
    }
    interface (all | [ interface-names ]) {
        session-expiry seconds;
        quiet-period seconds;
        reauthentication {
            interval seconds;
        }
        retries number;
        server-timeout seconds;
        supplicant (single | single-secure | multiple);
        dot1x {
            disable;
            guest-vlan (vlan-id | vlan-name);
            mac-radius {
                flap-on-disconnect;
                restrict;
            }
            maximum-requests number;
            no-reauthentication;
            server-fail (deny | permit | use-cache | vlan-id | vlan-name);
            server-reject-vlan (vlan-id | vlan-name) {
                eapol-block;
                block-interval block-interval;
            }
            supplicant-timeout seconds;
            transmit-period seconds;
        }
    }
    (captive-portal | no-captive-portal);
}
```

**Hierarchy Level** [edit protocols]

**Release Information** Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description** Configure an authenticator for 802.1X and captive-portal authentication.

The statements are explained separately.



**NOTE:** You cannot configure 802.1X user authentication on interfaces that have been enabled for Q-in-Q tunneling.

---

**Default** No static MAC address or VLAN is configured.

**Required Privilege** routing—To view this statement in the configuration.

**Level** routing-control—To add this statement to the configuration.

---

## authentication-profile-name

---

**Syntax** authentication-profile-name *access-profile-name*;

**Hierarchy Level** [edit protocols dot1x [authenticator](#)]

**Release Information** Statement introduced in Junos OS Release 9.3.

**Description** Specify the RADIUS authentication profile to use for user authentication when establishing an IEEE 802.1x Port-Based Network Access Control (**dot1x**) connection.

**Required Privilege** interface—To view this statement in the configuration.

**Level** interface control—To add this statement to the configuration.

- Related Documentation**
- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
  - [authenticator on page 881](#)
  - [dot1x on page 931](#)

## authenticator

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> authenticator {   authentication-profile-name <i>access-profile-name</i>;   interface <i>interface-id</i> {     maximum-requests <i>integer</i>;     quiet-period <i>seconds</i>;     reauthentication (disable   interval <i>seconds</i>);     retries <i>integer</i>;     server-timeout <i>seconds</i>;     supplicant (<i>single</i>);     supplicant-timeout <i>seconds</i>;     transmit-period <i>seconds</i>;   } } </pre> |
| <b>Hierarchy Level</b>          | [edit protocols dot1x]                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Specify an authentication profile for user or client authentication and configure the Ethernet interface for 802.1x protocol operation.                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b>authentication-profile-name <i>access-profile-name</i></b>—Specifies the RADIUS authentication profile for user or client authentication.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | <p>protocols—To view this statement in the configuration.</p> <p>protocols-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authentication-profile-name on page 880</a></li> <li>• <a href="#">dot1x on page 931</a></li> </ul>                                                                                                                                                                                    |

## auto-discovery

---

|                                 |                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | auto-discovery;                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management</a> maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> <a href="#">mep mep-id</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                        |
| <b>Description</b>              | Enable the MEP to accept continuity check messages from all remote MEPs.                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li></ul>                                     |

## auto-negotiation

|                            |                                                                                                                                                                                                                                  |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | (auto-negotiation   no-auto-negotiation) <remote-fault (local-interface-online   local-interface-offline)>;                                                                                                                      |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> ether-options],<br>[edit interfaces <i>interface-name</i> <b>gigether-options</b> ],<br>[edit interfaces <i>ge-pim</i> /0/0 <b>switch-options</b> <b>switch-port</b> <i>port-number</i> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 7.6.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                  |
| <b>Description</b>         | For Gigabit Ethernet interfaces on M Series, MX Series, T Series, TX Matrix routers, and ACX Series routers explicitly enable autonegotiation and remote fault. For EX Series switches, explicitly enable autonegotiation only.  |

- **auto-negotiation**—Enables autonegotiation. This is the default.
- **no-auto-negotiation**—Disable autonegotiation. When autonegotiation is disabled, you must explicitly configure the link mode and speed.

When you configure Tri-Rate Ethernet copper interfaces to operate at 1 Gbps, autonegotiation must be enabled.



**NOTE:** On EX Series switches, an interface configuration that disables autonegotiation and manually sets the link speed to 1 Gbps is accepted when you commit the configuration; however, if the interface you are configuring is a Tri-Rate Ethernet copper interface, the configuration is ignored as invalid and autonegotiation is enabled by default.

To correct the invalid configuration and disable autonegotiation:

1. Delete the **no-auto-negotiation** statement and commit the configuration.
2. Set the link speed to 10 or 100 Mbps, set **no-auto-negotiation**, and commit the configuration.

On EX Series switches, if the link speed and duplex mode are also configured, the interfaces use the values configured as the desired values in the negotiation. If autonegotiation is disabled, the link speed and link mode must be configured.



**NOTE:** On T4000 routers, the **auto-negotiation** command is ignored for interfaces other than Gigabit Ethernet.

|                                 |                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Default</b>                  | Autonegotiation is automatically enabled. No explicit action is taken after the autonegotiation is complete or if the negotiation fails.                                                                                                                                                    |
| <b>Options</b>                  | <b>remote-fault (local-interface-online   local-interface-offline)</b> —(Optional) For M Series, MX Series, T Series, TX Matrix routers, and ACX Series routers only, manually configure remote fault on an interface.<br><b>Default:</b> local-interface-online                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Gigabit Ethernet Autonegotiation Overview on page 477</a></li><li>• <a href="#">Configuring Gigabit Ethernet Interfaces (CLI Procedure)</a></li><li>• <a href="#">Configuring Gigabit Ethernet Interfaces (CLI Procedure)</a></li></ul> |

---

## auto-reconnect

|                                 |                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | auto-reconnect <i>seconds</i> ;                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <b>pppoe-options</b> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>pppoe-options</b> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                 |
| <b>Description</b>              | PPP over Ethernet interfaces, configure the amount of time to wait before reconnecting after a session has terminated.                                                                                                                            |
| <b>Options</b>                  | <b>seconds</b> —Time to wait before reconnecting after a session has terminated.<br><b>Range:</b> 0 through 4,294,967,295 seconds<br><b>Default:</b> 0 (immediately)                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the PPPoE Automatic Reconnect Wait Timer on page 331</a></li><li>• <a href="#">Junos OS Interfaces and Routing Configuration Guide</a></li></ul>                                  |



## avg-fd-twoway-threshold

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>avg-fd-twoway-threshold avg-fd-twoway-threshold-value;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</a> <i>profile-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | <p>Configure the threshold value for average frame delay, in microseconds, for two-way Ethernet frame delay measurement (ETH-DM). When the configured threshold for average frame delay is exceeded, an SNMP trap is generated for ETH-DM. SNMP traps are triggered if you configure either the average frame-delay threshold or the average inter-frame delay variance threshold. If you do not configure either the frame-delay threshold or the frame delay variation threshold, no SNMP traps are generated. You can configure these threshold values only with a two-way ETH-DM SLA iterator.</p> <p>Frame delay refers to the difference, in microseconds, between the time a frame is sent and when it is received. Frame delay variation refers to the difference, in microseconds, between consecutive frame delay values. Frame delay variation is sometimes called “frame jitter.” For one-way Ethernet frame delay measurement, only the receiver MEP (on the remote system) collects statistics. For two-way Ethernet frame delay measurement, only the initiator MEP (on the local system) collects statistics.</p> |
| <b>Options</b>                  | <p><b><i>avg-fd-twoway-threshold-value</i></b>—Threshold value for average frame delay, in microseconds, for two-way ETH-DM.</p> <p><b>Range:</b> 1 through 4294967295 microseconds</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Required Privilege Level</b> | <p>Configure—To enter configuration mode.</p> <p>Control—To modify any configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an Iterator Profile on page 652</a></li> <li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## avg-ifdv-twoway-threshold

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>avg-ifdv-twoway-threshold <i>avg-ifdv-twoway-threshold-value</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</a> <i>profile-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Configure the threshold value for average frame delay variation, in microseconds, for two-way Ethernet frame delay measurement (ETH-DM). When the configured threshold for average frame delay variation is exceeded, an SNMP trap is generated for ETH-DM. SNMP traps are triggered if you configure either the average frame-delay threshold or the average inter-frame delay variance threshold. If you do not configure either the frame-delay threshold or the frame delay variation threshold, no SNMP traps are generated. You can configure these threshold values only with a two-way ETH-DM SLA iterator.</p> <p>Frame delay refers to the difference, in microseconds, between the time a frame is sent and when it is received. Frame delay variation refers to the difference, in microseconds, between consecutive frame delay values. Frame delay variation is sometimes called “frame jitter.” For one-way Ethernet frame delay measurement, only the receiver MEP (on the remote system) collects statistics. For two-way Ethernet frame delay measurement, only the initiator MEP (on the local system) collects statistics. In two-way ETH-DM mode, frame delay and frame delay variation values are based on the time difference between when the initiator MEP transmits a request frame and receives a reply frame from the responder MEP, subtracting the time elapsed at the responder MEP.</p> |
| <b>Options</b>                  | <p><b><i>avg-ifdv-twoway-threshold-value</i></b>—Threshold value for average frame delay variation, in microseconds, for two-way ETH-DM.</p> <p><b>Range:</b> 1 through 4294967295 microseconds</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>configure—To enter configuration mode.</p> <p>control—To modify any configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <i>Configuring an Iterator Profile on a Switch (CLI Procedure)</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## avg-flr-forward-threshold


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>avg-flr-forward-threshold <i>avg-flr-forward-threshold-value</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">performance-monitoring</a> <a href="#">sla-iterator-profiles</a> <i>profile-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p>Configure the threshold value for average frame loss ratio, in milli-percent, in the upstream or forward direction for Ethernet loss measurement (ETH-LM) and Ethernet synthetic loss measurement (ETH-SLM). When the configured threshold for average forward frame loss ratio is exceeded, an SNMP trap is generated for ETH-LM and ETH-SLM. SNMP traps are triggered if you configure either the average backward frame loss ratio threshold or the average forward frame loss ratio threshold. If you do not configure either the average backward frame loss ratio threshold or the average forward frame loss ratio threshold, no SNMP traps are generated. You can configure these threshold values with an SLA iterator for ETH-SLM and ETH-LM.</p> <p>ETH-SLM is an application that enables the calculation of frame loss by using synthetic frames instead of data traffic. This mechanism can be considered as a statistical sample to approximate the frame loss ratio of data traffic.</p> |
| <b>Options</b>                  | <p><b><i>avg-flr-forward-threshold-value</i></b>—Threshold value for average frame loss ratio in the forward or upstream direction, in milli-percent, for ETH-SLM and ETH-LM.</p> <p><b>Range:</b> 1 through 100000 milli-percent</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | <p><b>configure</b>—To enter configuration mode.</p> <p><b>control</b>—To modify any configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an Iterator Profile on page 652</a></li> <li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## avg-flr-backward-threshold

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <code>avg-flr-backward-threshold <i>avg-flr-backward-threshold-value</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Hierarchy Level          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">performance-monitoring</a> <a href="#">sla-iterator-profiles</a> <i>profile-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Release Information      | Statement introduced in Junos OS Release 15.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description              | <p>Configure the threshold value for average frame loss ratio, in milli-percent, in the backward or downstream direction for Ethernet loss measurement (ETH-LM) and Ethernet synthetic loss measurement (ETH-SLM). When the configured threshold for average backward frame loss ratio is exceeded, an SNMP trap is generated for ETH-LM and ETH-SLM. SNMP traps are triggered if you configure either the average backward frame loss ratio threshold or the average forward frame loss ratio threshold. If you do not configure either the average backward frame loss ratio threshold or the average forward frame loss ratio threshold, no SNMP traps are generated. You can configure these threshold values with an SLA iterator for ETH-SLM and ETH-LM.</p> <p>ETH-SLM is an application that enables the calculation of frame loss by using synthetic frames instead of data traffic. This mechanism can be considered as a statistical sample to approximate the frame loss ratio of data traffic.</p> |
| Options                  | <p><b><i>avg-flr-backward-threshold-value</i></b>—Threshold value for average frame loss ratio in the backward or downstream direction, in milli-percent, for ETH-SLM and ETH-LM.</p> <p><b>Range:</b> 1 through 100000 milli-percent</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Required Privilege Level | <p>configure—To enter configuration mode.</p> <p>control—To modify any configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## backward-frr-enable

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (backward-frr-enable   no-backward-frr-enable);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options preemptive-fast-reroute</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | <p>Enable or disable backward fast reroute status insertion.</p> <p>Enable backward fast reroute to insert local pre-forward error correction (FEC) bit error rate (BER) status into transmitted OTN frames, notifying the remote interface. The remote interface can use the information to reroute traffic to a different interface. When you enable backward fast reroute and also enable pre-FEC BER monitoring including the <a href="#">signal-degrade-monitor-enable</a> statement, notification of signal degradation and rerouting of traffic occurs in less time than that required through a Layer 3 protocol.</p>                                                                                                      |
|                                 | <p> <b>NOTE:</b> When you configure pre-FEC BER signal degrade monitoring, we recommend that you configure both the <a href="#">signal-degrade-monitor-enable</a> and <a href="#">backward-frr-enable</a> statements.</p>                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                 | <p>You can also configure the pre-FEC BER thresholds that raise or clear a signal degrade alarm and the time interval for the thresholds. If the BER thresholds and interval are not configured, the default values are used. Include the <a href="#">ber-threshold-signal-degrade value</a>, <a href="#">ber-threshold-clear value</a>, and <a href="#">interval value</a> statements at the [edit interfaces <i>interface-name</i> <b>otn-options signal-degrade</b>] hierarchy level to configure the BER thresholds and time interval. See “Understanding Pre-FEC BER Monitoring and BER Thresholds” on <a href="#">page 431</a> for more information about pre-FEC BER monitoring and determining BER threshold settings.</p> |
| <b>Default</b>                  | By default, backward fast reroute insertion is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | <p><b>backward-frr-enable</b>—Enable backward fast reroute status insertion.</p> <p><b>no-backward-frr-enable</b>—Do not enable backward fast reroute status insertion.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Understanding Pre-FEC BER Monitoring and BER Thresholds on page 431</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                |

## bandwidth-limit (Policer for Gigabit Ethernet Interfaces)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>bandwidth-limit <i>bps</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <i>gigether-options</i> <a href="#">ethernet-switch-profile ethernet-policer-profile</a> <i>policer cos-policer-name aggregate</i> ],<br>[edit interfaces <i>interface-name</i> <i>gigether-options</i> <a href="#">ethernet-switch-profile ethernet-policer-profile</a> <i>policer cos-policer-name premium</i> ]                                                                   |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Define a policer to apply to nonpremium traffic.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <b><i>bps</i></b> —Bandwidth limit, in bits per second. Specify either as a complete decimal number or as a decimal number followed by the abbreviation <b>k</b> (1000), <b>m</b> (1,000,000), or <b>g</b> (1,000,000,000).<br><br><b>Range:</b> 32 Kbps through 32 gigabits per second (Gbps). For IQ2 and IQ2-E interfaces 65,536 bps through 1 Gbps. For 10-Gigabit IQ2 and IQ2-E interfaces 65,536 bps through 10 Gbps. |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li><li>• <a href="#">burst-size-limit (Policer for Gigabit Ethernet Interfaces) on page 901</a></li></ul>                                                                                                                                                                                                        |


---

## bridge-domain

---

|                                 |                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>bridge-domain <i>name</i>;</code><br><code>  vlan-id [ <i>vlan-identifiers</i> ];</code><br><code>}</code>                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>maintenance-domain-name</i> ],<br>[edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>maintenance-domain-name</i> virtual-switch <i>virtual-switch-name</i> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                                                                               |
| <b>Description</b>              | (MX Series routers only) Specify the OAM Ethernet CFM maintenance domain bridge domain.                                                                                                                                                                                     |
| <b>Options</b>                  | <i>name</i> —Specify the name of the bridge domain.<br><br><i>vlan-identifiers</i> —Specify one or more VLAN identifiers.                                                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Maintenance Intermediate Points (MIPs) on page 526</a></li><li>• <a href="#">maintenance-domain on page 1053</a></li></ul>                                                                                  |

## bridge-domains

|                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                     | <pre> bridge-domains {   bridge-domain-name {     bridge-options {       ...bridge-options-configuration...     }     domain-type bridge;     interface <i>interface-name</i>;     no-irb-layer-2-copy;     routing-interface <i>routing-interface-name</i>;     vlan-id (all   none   <i>number</i>);     vlan-id-list [ <i>vlan-id-numbers</i> ];     vlan-tags outer <i>number</i> inner <i>number</i>;     bridge-options {       interface <i>interface-name</i> {         static-mac <i>mac-address</i>;       }       interface-mac-limit <i>limit</i>;       mac-statistics;       mac-table-size <i>limit</i>;       no-mac-learning;     }   } } </pre> |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                            | [edit],<br>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>                                                                                                                                                                                                                                        | Statement introduced in Junos OS Release 8.4.<br>Support for logical systems added in Junos OS Release 9.6.<br>Support for the <b>no-irb-layer-2-copy</b> statement added in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>                                                                                                                                                                                                                                                | (MX Series routers only) Configure a domain that includes a set of logical ports that share the same flooding or broadcast characteristics in order to perform Layer 2 bridging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                                                                                                                                                                                                                                                    | <b>bridge-domain-name</b> —Name of the bridge domain.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <div style="text-align: center;">  <b>NOTE:</b> You cannot use the slash (/) character as part of the bridge domain name. If you do, the configuration will not commit. </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| The remaining statements are explained separately.                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                   | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Configuring a Bridge Domain</li> <li>Configuring a Layer 2 Virtual Switch</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



- *Example: Configuring E-LINE and E-LAN Services for a PBB Network on MX Series Routers*

## ber-threshold-clear

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>ber-threshold-clear value;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>otn-options</b> <b>signal-degrade</b> ]<br>[edit interfaces <i>interface-name</i> <b>otn-options</b> <b>odu-signal-degrade</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b> | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>         | <p>Specify bit error rate (BER) threshold to clear the interface alarm for signal degradation.</p> <p>You can configure the BER clear threshold to customize the BER that will clear an interface alarm when signal degrade monitoring is enabled.</p> <p>If you configure the BER thresholds at the [edit interfaces <i>interface-name</i> <b>otn-options</b> <b>signal-degrade</b>] hierarchy level, then the thresholds are calculated using the pre-forward error correction (pre-FEC) BER (the BER before FEC correction). These thresholds are used for pre-FEC BER monitoring. See “<a href="#">Understanding Pre-FEC BER Monitoring and BER Thresholds</a>” on page 431 for more information about pre-FEC BER monitoring and determining BER threshold settings.</p> <p>If you configure the BER thresholds at the [edit interfaces <i>interface-name</i> <b>otn-options</b> <b>odu-signal-degrade</b>] hierarchy level, then the thresholds are calculated using the post-FEC BER (the BER after FEC correction). This BER is referred to as the optical channel data unit (ODU) BER.</p> |



**NOTE:** You can configure ODU BER thresholds only at the [edit interfaces *interface-name* **otn-options** **odu-signal-degrade**] hierarchy level on the P2-100GE-OTN PIC.

Table 78 on page 894 shows the default values for pre-FEC BER and ODU BER signal degrade threshold values for different PICs. If the BER signal degrade threshold is not configured, the default value is used.

**Table 78: Default Clear Threshold Values**

| PIC                  | Default Pre-FEC BER Clear Threshold Value | Default ODU BER Clear Threshold Value |
|----------------------|-------------------------------------------|---------------------------------------|
| P1-PTX-2-100G-WDM    | 3.0E-3                                    | Not supported                         |
| P2-100GE-OTN         | 3.0E-3                                    | 1.0E-9                                |
| P1-PTX-24-10G-W-SFPP | 3.0E-3                                    | Not supported                         |

To configure the threshold that raises the signal degrade alarm, include the **ber-threshold-signal-degrade** statement at the same hierarchy level. To configure the

time interval during which the BER must stay above or below the configured thresholds to raise or clear the alarm, include the [interval](#) statement at the same hierarchy level.



**NOTE:** For the P1-PTX-2-100G-WDM PIC, the BER must stay above the signal degradation threshold for ten consecutive intervals for the alarm to be raised and the BER must stay below the clear threshold for ten consecutive intervals for the alarm to be cleared. For example, if the interval is configured as 10 ms, then the BER must stay above the signal degradation threshold for 100 ms (10 ms \* 10 intervals) for the alarm to be raised, or below the clear threshold for 100 ms for the alarm to be cleared.

**Options** **Values:** *value*—BER threshold for clearing the signal degradation in scientific notation. Both the mantissa and exponent are configurable. Enter the value in the format  $x\text{E}-n$ , where  $x$  is the mantissa and  $n$  is the exponent. For example, 4.5E-3.

**Range:** The mantissa must be a decimal number. There is no limit on the number of digits before or after the decimal point. The exponent must be an integer from 0 through 9.

**Default:** See [Table 78 on page 894](#) for the default values.



**BEST PRACTICE:** Always set the *ber-threshold-clear value* lower than the *ber-threshold-signal-degrade value*. For the FEC limits, see the table describing the signal degrade and clear thresholds after configuration in “[Understanding Pre-FEC BER Monitoring and BER Thresholds](#)” on page 431.



**NOTE:** In Junos OS Release 13.2R1, only the exponent is valid input for the BER threshold value, and the mantissa is not configurable. The BER threshold value is  $1.0\text{E}-n$  where  $n > 0$ , and the valid range of  $n$  is from 1 through 10.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Understanding Pre-FEC BER Monitoring and BER Thresholds on page 431](#)
- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## ber-threshold-signal-degrade

|                            |                                                                                                                                                                                                                                                             |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>ber-threshold-signal-degrade value;</code>                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>     | <code>[edit interfaces <i>interface-name</i> otn-options signal-degrade]</code><br><code>[edit interfaces <i>interface-name</i> otn-options odu-signal-degrade]</code>                                                                                      |
| <b>Release Information</b> | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                       |
| <b>Description</b>         | Specify the bit error rate (BER) threshold to raise an interface alarm for signal degradation.<br><br>You can configure the BER signal degrade threshold to customize the BER that will raise an interface alarm when signal degrade monitoring is enabled. |



**NOTE:** Configuring a high BER threshold for signal degradation and a long interval might cause the internal bit error counter register to get saturated. For example, for the P1-PTX-2-100G-WDM PIC, the internal bit error counter gets saturated when the error count reaches  $2E+29$ . Therefore, the value of `ber-threshold-signal-degrade * line rate / interval` must be less than  $2E+29$  to avoid saturation. Assuming a fixed PIC line rate of  $1.27E+11$  bits per second and an interval of 1000 ms, the `ber-threshold-signal-degrade` value must be less than  $4.22E-3$ .

If the value of the `ber-threshold-signal-degrade * line rate / interval` exceeds the saturation limit, the configuration is ignored by the router, and the default values are used instead. A system log message is logged for this error.

If you configure the BER thresholds at the `[edit interfaces interface-name otn-options signal-degrade]` hierarchy level, then the thresholds are calculated using the pre-forward error correction (pre-FEC) BER (the BER before FEC correction). These thresholds are used for pre-FEC BER monitoring. See “[Understanding Pre-FEC BER Monitoring and BER Thresholds](#)” on page 431 for more information about pre-FEC BER monitoring and determining BER threshold settings.

If you configure the BER thresholds at the `[edit interfaces interface-name otn-options odu-signal-degrade]` hierarchy level, then the thresholds are calculated using the post-FEC BER (the BER after FEC correction). This BER is referred to as the optical channel data unit (ODU) BER.



**NOTE:** You can configure ODU BER thresholds only at the `[edit interfaces interface-name otn-options odu-signal-degrade]` hierarchy level on the P2-100GE-OTN PIC.

Table 79 on page 897 shows the default values for pre-FEC BER and ODU BER signal degrade threshold values for different PICs. If the BER signal degrade threshold is not configured, the default value is used.

**Table 79: Default Signal Degrade Threshold Values**

| PIC                  | Default Pre-FEC BER Signal Degrade Threshold Value | Default ODU BER Signal Degrade Threshold Value |
|----------------------|----------------------------------------------------|------------------------------------------------|
| P1-PTX-2-100G-WDM    | 7.5E-3                                             | Not supported                                  |
| P2-100GE-OTN         | 7.5E-3                                             | 1.0E-6                                         |
| P1-PTX-24-10G-W-SFPP | 7.5E-3                                             | Not supported                                  |

To configure the threshold that clears the signal degrade alarm, include the **ber-threshold-clear** statement at the same hierarchy level. To configure the time interval during which the BER must stay above or below the configured thresholds to raise or clear the alarm, include the **interval** statement at the same hierarchy level.



**NOTE:** For the P1-PTX-2-100G-WDM PIC, the BER must stay above the signal degradation threshold for ten consecutive intervals for the alarm to be raised and the BER must stay below the clear threshold for ten consecutive intervals for the alarm to be cleared. For example, if the interval is configured as 10 ms, then the BER must stay above the signal degradation threshold for 100 ms (10 ms \* 10 intervals) for the alarm to be raised, or below the clear threshold for 100 ms for the alarm to be cleared.

**Options**    **value**—BER threshold for signal degradation in scientific notation. Both the mantissa and exponent are configurable. Enter the value in the format  $x\text{E}-n$ , where  $x$  is the mantissa and  $n$  is the exponent. For example, 4.5E-3.

**Range:** The mantissa must be a decimal number. There is no limit on the number of digits before or after the decimal point. The exponent must be an integer from 0 through 9.

**Default:** See [Table 79 on page 897](#).



**NOTE:** In Junos OS Release 13.2R1, only the exponent is valid input for the BER threshold value, the mantissa is not configurable. The BER threshold value is  $1.0\text{E}-n$  where  $n > 0$ , and the valid range of  $n$  is from 1 through 10.

---



**BEST PRACTICE:** To enable proactive protection before packet loss occurs, set the `ber-threshold-signal-degrade value` below the FEC limit. For the FEC limits, see the table describing the signal degrade and clear thresholds after configuration in “[Understanding Pre-FEC BER Monitoring and BER Thresholds](#)” on [page 431](#).

---

**Required Privilege Level**    interface—To view this statement in the configuration.  
                                         interface-control—To add this statement to the configuration.

**Related Documentation**

- [Understanding Pre-FEC BER Monitoring and BER Thresholds on page 431](#)
- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## bfd-liveness-detection (LAG)

**Syntax**

```

bfd-liveness-detection {
    authentication {
        algorithm algorithm-name;
        key-chain key-chain-name;
        loose-check;
    }
    detection-time {
        threshold milliseconds;
    }
    holddown-interval milliseconds;
    local-address bfd-local-address;
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    multiplier number;
    neighbor bfd-neighbor-address;
    no-adaptation;
    transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
    }
    version (1 | automatic);
}

```

**Hierarchy Level** [edit interfaces *aex* aggregated-ether-options]

**Release Information** Statement introduced in Junos OS Release 13.3.

**Description** Configure Bidirectional Forwarding Detection (BFD) timers and authentication for aggregated Ethernet interfaces.

**Options** **holddown-interval *milliseconds***— Specify a time limit in milliseconds indicating the time that a BFD session remains up before a state change notification is sent. If the BFD session goes down and then comes back up during the hold-down interval, the timer is restarted.

**Range:** 0 through 255,000

**Default:** 0

**local-address *bfd-local-address***— Specify the loopback address of the source of the BFD session.

**minimum-interval *milliseconds***— Specify a minimum time interval after which the local routing device transmits a BFD packet and then expects to receive a reply from the BFD neighbor. Optionally, instead of using this statement, you can configure the minimum transmit and receive intervals separately using the **transmit-interval** **minimum-interval** statement.

**Range:** 1 through 255,000

**minimum-receive-interval *milliseconds***— Specify the minimum time interval after which the routing device expects to receive a reply from the BFD neighbor.

**Range:** 1 through 255,000

**multiplier *number***— Specify the number of BFD packets that were not received by the BFD neighbor before the originating interface is declared down.

**Range:** 1 through 255

**neighbor *bfd-neighbor-address***— Specify the loopback address of a remote destination to send BFD packets.

**no-adaptation**— Disable the BFD adaptation. Include this statement if you do not want the BFD sessions to adapt to changing network conditions. We recommend that you do not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

**version**— Configure the BFD version to detect (BFD version 1) or autodetect (the BFD version).

**Default:** automatic

The remaining statements are explained separately.

|                           |                                                               |
|---------------------------|---------------------------------------------------------------|
| <b>Required Privilege</b> | interface—To view this statement in the configuration.        |
| <b>Level</b>              | interface-control—To add this statement to the configuration. |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <i>authentication</i></li><li>• <i>detection-time</i></li><li>• <i>transmit-interval</i></li><li>• <i>Configuring Independent Micro BFD Sessions for LAG</i></li><li>• <a href="#">Example: Configuring Independent Micro BFD Sessions for LAG on page 192</a></li><li>• <a href="#">Understanding Independent Micro BFD Sessions for LAG on page 189</a></li></ul> |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



## burst-size-limit (Policer for Gigabit Ethernet Interfaces)

|                                 |                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>burst-size-limit bytes;</code>                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <code>gigether-options ethernet-switch-profile ethernet-policer-profile</code> <code>policer cos-policer-name aggregate</code> ],<br>[edit interfaces <i>interface-name</i> <code>gigether-options ethernet-switch-profile ethernet-policer-profile</code> <code>policer cos-policer-name premium</code> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Define a policer to apply to nonpremium traffic.                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <b>bytes</b> —Burst length.<br><b>Range:</b> 1500 through 100,000,000 bytes                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | <code>interface</code> —To view this statement in the configuration.<br><code>interface-control</code> —To add this statement to the configuration.                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li> <li>• <a href="#">bandwidth-limit (Policer for Gigabit Ethernet Interfaces) on page 890</a></li> </ul>                                                                                                                            |

## bypass

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>(bypass   no-bypass);</code>                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <code>otn-options odu-delay-management</code> ]                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                |
| <b>Description</b>              | Pass or do not pass the delay measurement (DM) value through a node.                                                                                                                                                 |
| <b>Default</b>                  | If you omit the <code>bypass</code> statement, the default behavior is to disable ODU delay management options.<br><br>By default, do not pass the DM value through a node.                                          |
| <b>Options</b>                  | <b>bypass</b> —Pass the DM value through a node.<br><br><b>no-bypass</b> —Do not pass the DM value through a node.                                                                                                   |
| <b>Required Privilege Level</b> | <code>interface</code> —To view this statement in the configuration.<br><code>interface-control</code> —To add this statement to the configuration.                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## bytes (otn-options)

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | bytes transmit-payload-type <i>value</i> ;                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify the transmit payload type on OTN header bytes.                                                                                                                                                            |
| <b>Options</b>                  | <i>value</i> —Transmit payload type.<br><b>Range:</b> 0 through 255 bytes                                                                                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## cak (MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ckn <i>hexadecimal-number</i> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> pre-shared-key]                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | <p>Specifies the connectivity association key (CAK) for a pre-shared key.</p> <p>A pre-shared key includes a connectivity association key name (CKN) and a CAK. A pre-shared key is exchanged between two devices at each end of a point-to-point link to enable MACsec using dynamic security keys. The MACsec Key Agreement (MKA) protocol is enabled once the pre-shared keys are successfully exchanged. The pre-shared key—the CKN and CAK—must match on both ends of a link</p> |
| <b>Default</b>                  | No CAK exists, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <i>hexadecimal-number</i> —The key name, in hexadecimal format.<br>The key name is 32 hexadecimal characters in length. If you enter a key name that is less than 32 characters long, the remaining characters are set to 0.                                                                                                                                                                                                                                                          |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                  |

## calculation-weight

|                            |                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | calculation-weight {<br><code>delay</code> <i>delay-value</i> ;<br><code>delay-variation</code> <i>delay-variation-value</i> ;<br>}        |
| <b>Hierarchy Level</b>     | [edit protocols <code>oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</code> <i>profile-name</i> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                    |
| <b>Description</b>         | Configure the calculation weight for delay and delay variation.                                                                            |



**NOTE:** This option is applicable only for two-way delay measurement.

The remaining statements are explained separately.

|                                 |                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an Iterator Profile on page 652</a></li> <li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li> <li>• <a href="#">delay on page 922</a></li> <li>• <a href="#">delay-variation on page 924</a></li> </ul> |

## **captive-portal (MX Series in Enhanced LAN Mode)**

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (captive-portal   no-captive-portal);                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Specify whether captive portal authentication needs to be enabled or disabled. You can set up captive portal authentication (hereafter referred to as captive portal) on a switch to redirect Web browser requests to a login page that requires the user to input a username and password. Upon successful authentication, the user is allowed to continue with the original page request and subsequent access to the network. |
| <b>Default</b>                  | Not enabled                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <b>captive-portal</b> —Enable captive portal authentication.<br><b>no-captive-portal</b> —Disable captive portal authentication.                                                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | security—To view this statement in the configuration.<br>security-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                            |

## captive-portal-custom-options (MX Series in Enhanced LAN Mode)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre> captive-portal-custom-options {   banner-message <i>string</i>;   footer-bgcolor <i>color</i>;   footer-message <i>string</i>;   footer-text-color <i>color</i>;   form-header-bgcolor <i>color</i>;   form-header-message <i>string</i>;   form-header-text-color <i>color</i>;   form-reset-label <i>label name</i>;   form-submit-label <i>label name</i>;   header-bgcolor <i>color</i>;   header-logo <i>filename</i>;   header-message <i>string</i>;   header-text-color <i>color</i>;   post-authentication-url <i>url-string</i>; } </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>     | [edit protocols]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b> | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>         | Specify the design elements of a captive portal login page.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Options</b>             | <p><b>banner-message</b>—The first screen displayed before the captive portal login page is displayed—for example, a disclaimer message.<br/> <b>Range:</b> 1–2047 characters</p> <p><b>footer-bgcolor</b> —The hexadecimal color code for the color of the footer bar across the bottom of the captive portal login page—for example, #2E8B57 (sea green).<br/> <b>Values:</b> # symbol followed by six characters.</p> <p><b>footer-message</b>—Text message displayed in the footer bar across the bottom of the captive portal login page.<br/> <b>Range:</b> 1–2047 characters<br/> <b>Default:</b> Copyright ©2010, Juniper Networks Inc.</p> <p><b>footer-text-color</b> — Color of the text in the footer.<br/> <b>Default:</b> The default color is white.</p> <p><b>form-header-bgcolor</b> —The hexadecimal color code for the background color of the header bar across the top of the form area of the captive portal login page.<br/> <b>Values:</b> # symbol followed by six characters.</p> <p><b>form-header-message</b>—Text message displayed in the header bar across the top of the form area of the captive portal login page.<br/> <b>Range:</b> 1–255 characters<br/> <b>Default:</b> Captive Portal User Authentication</p> |

**form-header-text-color**—Color of the text in the form header.

**Default:** The default color is black.

**form-reset-label**—Label displayed in the button that the user can select to clear the username and password fields on the form.

**Range:** 1–255 characters

**Default:** Reset

**form-submit-label**—Label displayed in the button that the user selects to submit their login information—for example, **Log In**.

**Range:** 1–255 characters

**Default:** Log In

**header-bgcolor**—The hexadecimal color code for the color of the header bar across the top of the captive portal login page.

**Values:** # symbol followed by six characters.

**header-logo**—Filename of the file containing the image of the logo displayed at the top of the captive portal login page. The image file can be in GIF, JPEG, or PNG format.

**Default:** The Juniper Networks logo

**header-message**—Text displayed in the header bar across the bottom of the captive portal login page.

**Range:** 1–2047 characters

**Default:** User Authentication

**header-text-color**—Color of the text in the header.

**Default:** The default color is white.


**post-authentication-url**—URL to which the users are directed upon successful authentication—for example **www.mycafe.com**.

**Range:** 1–255 characters

**Default:** The page originally requested by the user.

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|

## centralized

|                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                               | centralized;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                      | [edit protocols lacp ppm]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                  | Statement introduced in Junos OS Release 9.4 for MX Series routers.<br>Statement introduced in Junos OS Release 10.2 for EX Series switches.<br>Statement introduced in Junos OS Release 11.3 for the QFX Series.<br>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.                                                                                                                                                                                                                    |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                          | <p>Disable distributed periodic packet management (PPM) processing for Link Aggregation Control Protocol (LACP) packets and run all PPM processing for LACP packets on the Routing Engine.</p> <p>This statement disables distributed PPM processing for only LACP packets. You can disable distributed PPM processing for all packets that use PPM and run all PPM processing on the Routing Engine by configuring the <b>no-delegate-processing</b> statement in the [edit routing-options ppm] hierarchy.</p> |
| <div>  <p><b>BEST PRACTICE:</b> We generally recommend that you disable distributed PPM only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM only if you have a compelling reason to disable it.</p> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Default</b>                                                                                                                                                                                                                                                                                                                              | Distributed PPM processing is enabled for all packets that use PPM.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                             | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>• <i>Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)</i></li> <li>• <i>Configuring Aggregated Ethernet LACP (CLI Procedure)</i></li> <li>• <a href="#">Configuring Distributed Periodic Packet Management on page 202</a></li> <li>• <i>Configuring Link Aggregation</i></li> </ul>                                                                                                                                             |

## chassis

---

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>chassis { ... }</code>                                                                                            |
| <b>Hierarchy Level</b>          | [edit]                                                                                                                  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                       |
| <b>Description</b>              | Configure router chassis properties.                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Router Chassis Configuration Statements</i></li></ul>                        |

## ckn (MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>ckn hexadecimal-number;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> pre-shared-key]                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | <p>Specifies the connectivity association key name (CKN) for a pre-shared key.</p> <p>A pre-shared key includes a CKN and a connectivity association key (CAK). A pre-shared key is exchanged between two devices at each end of a point-to-point link to enable MACsec using dynamic security keys. The MACsec Key Agreement (MKA) protocol is enabled once the pre-shared keys are successfully exchanged. The pre-shared key—the CKN and CAK—must match on both ends of a link</p> |
| <b>Default</b>                  | No CKN exists, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <p><i>hexadecimal-number</i>—The key name, in hexadecimal format.</p> <p>The key name is 32 hexadecimal characters in length. If you enter a key name that is less than 32 characters long, the remaining characters are set to 0.</p>                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                  |



## classifier

|                                 |                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> classifier {   per-unit-scheduler {     forwarding-class <i>class-name</i> {       loss-priority (high   low);     }   } } </pre>                                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">output-priority-map</a> ]                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                             |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the classifier for the output priority map to be applied to outgoing frames on this interface.</p> <p>The statements are explained separately.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Output Priority Map on page 465</a></li> <li>• <a href="#">input-priority-map on page 998</a></li> </ul>                                                   |

## clear

|                                 |                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | request protection-group ethernet-aps clear md <md> ma <ma>                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols protection-group ethernet-aps]                                                                                     |
| <b>Description</b>              | Clears the lockout, force switch, manual switch, exercise, and wait-to-restore (WTR) states.                                       |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p> |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Automatic Protection Switching Overview on page 205</a></li> </ul>   |

## client

|                                 |                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | client;                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces pp0 unit <i>logical-unit-number</i> <a href="#">pppoe-options</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces pp0 unit <i>logical-unit-number</i> <a href="#">pppoe-options</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                                                            |
| <b>Description</b>              | Configure the router to operate in the PPPoE client mode.                                                                                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Configuring the PPPoE Client Mode on page 331</a></li> </ul>                                                                                                          |

## community-vlans (MX Series)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | community-vlans [ <i>number number-number</i> ];                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>     | [edit <a href="#">bridge-domains</a> <i>bridge-domain-name</i> ],<br>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> <a href="#">bridge-domains</a> <i>bridge-domain-name</i> bridge-options],<br>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> <a href="#">bridge-domains</a> <i>bridge-domain-name</i> ],<br>[edit routing-instances <i>routing-instance-name</i> <a href="#">bridge-domains</a> <i>bridge-domain-name</i> ], |
| <b>Release Information</b> | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>         | Configure the specified community VLAN to be a secondary VLAN of the specified primary VLAN. A <i>community</i> VLAN is used to transport frames among members of a community, which is a subset of users within the VLAN, and to forward frames upstream to the primary VLAN.                                                                                                                                                                                                                                                    |



**NOTE:** When you specify this configuration statement, the VLAN ID of a logical interface that you associate with a bridge domain that matches with the VLAN ID or list of IDs that you specify using the `community-vlans` state is treated as a community port.

|                                 |                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Options</b>                  | <i>number</i> —Individual VLAN IDs separated by a space.                                                          |
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    |                                                                                                                   |

## compatibility-version

|                                 |                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | compatibility-version;                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify the compatible version mode to be used. When compatibility-version is set to value 1, the node operates in ITU-T Recommendation G.8032/Y.1344 version 1 compatible mode. In this mode all the supported external commands are blocked, ring-id is forced to be 1 and mode of operation is set to revertive mode. |
| <b>Options</b>                  | <ul style="list-style-type: none"> <li>• 1—Use ITU-T Recommendation G.8032/Y.1344 compatible mode version 1.</li> <li>• 2—Use ITU-T Recommendation G.8032/Y.1344 compatible mode version 2.</li> </ul>                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul>                                                                                                    |

## connectivity-association (MACsec Interfaces for MX Series)

|                                 |                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | connectivity-association <i>connectivity-association-name</i> ;                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit security macsec interfaces <i>interface-name</i> ]                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                               |
| <b>Description</b>              | Applies a connectivity association to an interface, which enables Media Access Control Security (MACsec) on that interface.                                                      |
| <b>Default</b>                  | No connectivity associations are associated with any interfaces.                                                                                                                 |
| <b>Options</b>                  | <i>connectivity-association-name</i> —Name of the MACsec connectivity association.<br><b>Range:</b> 1 through 32 alphanumeric characters. Allowed characters are [a-z, A-Z, 0-9] |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                           |

## connectivity-association (MX Series)

**Syntax** `connectivity-association connectivity-association-name {  
 exclude-protocol protocol-name;  
 include-sci;  
 mka {  
 must-secure;  
 key-server-priority priority-number;  
 transmit-interval interval;  
 }  
 no-encryption;  
 offset (0|30|50);  
 pre-shared-key {  
 cak hexadecimal-number;  
 ckn hexadecimal-number;  
 }  
 replay-protect {  
 replay-window-size number-of-packets;  
 }  
 secure-channel secure-channel-name {  
 direction (inbound | outbound);  
 encryption;  
 id {  
 mac-address mac-address;  
 port-id port-id-number;  
 }  
 offset (0|30|50);  
 security-association security-association-number {  
 key key-string;  
 }  
 }  
 security-mode security-mode;  
}`

**Hierarchy Level** [edit security macsec]

**Release Information** Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description** Create or configure a MACsec connectivity association.

A connectivity association is not applying MACsec to traffic until it is associated with an interface. MACsec connectivity associations are associated with interfaces using the **interfaces** statement in the [edit security macsec] hierarchy.

**Default** No connectivity associations are present, by default.

**Options** *connectivity-association-name*—Name of the MACsec connectivity association.

**Range:** 1 through 32 alphanumeric characters. Allowed characters are [a-z, A-Z, 0-9]

The remaining statements are explained separately.

**Required Privilege** admin—To view this statement in the configuration.  
**Level** admin-control—To add this statement to the configuration.

**Related Documentation** • [Configuring Media Access Control Security \(MACsec\) on MX Series Routers on page 93](#)

## connectivity-fault-management

```
Syntax connectivity-fault-management {
    action-profile profile-name {
        action {
            interface-down;
            log-and-generate-ais {
                interval(1m | 1s);
                levelvalue;
                priority value;
            }
        }
    }
    default-actions {
        interface-down;
    }
    event {
        ais-trigger-condition {
            adjacency-loss;
            all-defects;
            cross-connect-ccm;
            erroneous-ccm;
            receive-ais;
        }
        adjacency-loss;
        interface-status-tlv (down | lower-layer-down);
        port-status-tlv blocked;
        rdi;
    }
}
performance-monitoring {
    delegate-server-processing;
    hardware-assisted-timestamping;
    sla-iterator-profiles {
        profile-name {
            avg-fd-twoway-threshold;
            avg-ifdv-twoway-threshold;
            avg-flr-forward-threshold;
            avg-flr-backward-threshold;
            disable;
            calculation-weight {
                delay delay-weight;
                delay-variation delay-variation-weight;
            }
            cycle-time milliseconds;
            iteration-period connections;
            measurement-type (loss | statistical-frame-loss | two-way-delay);
        }
    }
}
linktrace {
    age (30m | 10m | 1m | 30s | 10s);
    path-database-size path-database-size;
}
maintenance-domain domain-name {
```

```

bridge-domain <vlan-id [ vlan-ids ]>;
instance routing-instance-name;
interface interface-name;
level number;
name-format (character-string | none | dns | mac+2oct);
maintenance-association ma-name {
    protect-maintenance-association protect-ma-name;
    remote-maintenance-association remote-ma-name;
    short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
    continuity-check {
        convey-loss-threshold;
        hold-interval minutes;
        interface-status-tlv;
        interval (10m | 10s | 1m | 1s | 100ms);
        loss-threshold number;
        port-status-tlv;
    }
    mep mep-id {
        auto-discovery;
        direction (up | down);
        interface interface-name (protect | working);
        lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect |
            rem-err-xcon | xcon );
        priority number;
        remote-mep mep-id {
            action-profile profile-name;
            sla-iterator-profile profile-name {
                data-tlv-size size;
                iteration-count count-value;
                priority priority-value;
                detect-loc;
            }
        }
    }
}
virtual-switch routing-instance-name {
    bridge-domain name <vlan-ids [ vlan-ids ]>;
}
}
no-aggregate-delegate-processing;
}

```

**Hierarchy Level** [edit protocols **oam** **ethernet**]

**Release Information** Statement introduced in Junos OS Release 8.4.

**Description** For Ethernet interfaces on M7i and M10i routers with Enhanced CFEB (CFEB-E), and on M120, M320, MX Series, and T Series routers, specify connectivity fault management for IEEE 802.1ag Operation, Administration, and Management (OAM) support. In Junos OS Release 9.3 and later, this statement is also supported on aggregated Ethernet interfaces.

The remaining statements are explained separately.

**Required Privilege** interface—To view this statement in the configuration.  
**Level** interface-control—To add this statement to the configuration.

**Related Documentation**

- [IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519](#)

---

## continuity-check

---

**Syntax**

```
continuity-check {  
    convey-loss-threshold;  
    hold-interval minutes;  
    interface-status-tlv;  
    interval (10m | 10s | 1m | 1s| 100ms | 10ms);  
    loss-threshold number;  
    port-status-tlv;  
}
```

**Hierarchy Level** [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* [maintenance-association](#) *ma-name*]

**Release Information** Statement introduced in Junos OS Release 8.4.

**Description** Specify continuity check protocol options.

**Options** **convey-loss-threshold**—Enable loss-threshold-tlv transmission.

**hold-interval** *minutes*—Specify the continuity check hold-interval, in minutes.

**interface-status-tlv**—Enable interface-status-tlv transmission.

**interval** (*10m | 10s | 1m | 1s| 100ms | 10ms*)—Specify the continuity check interval.

**loss-threshold** *minutes*—Specify the loss-threshold, in minutes.

**port-status-tlv**—Enable port-status-tlv transmission.

**Required Privilege** interface—To view this statement in the configuration.  
**Level** interface-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring Continuity Check Protocol Parameters for Fault Detection on page 529](#)



## control-channel

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | control-channel <i>channel-name</i> {<br>vlan <i>vlan-id</i> ;<br>interface name <i>interface-name</i><br>}                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols <b>protection-group ethernet-ring</b> <i>name</i> ( <b>east-interface</b>   <b>west-interface</b> )]                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                                                                                                     |
| <b>Description</b>              | Configure the Ethernet RPS control channel logical interface to carry the RAPS PDU. The related physical interface is the physical ring port.                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <b>vlan <i>vlan-id</i></b> —If the control channel logical interface is a trunk port, then a dedicated <b>vlan <i>vlan-id</i></b> defines the dedicated VLAN channel to carry the RAPS traffic. Only configure the <b>vlan-id</b> when the control channel logical interface is the trunk port.<br><br><b>interface name <i>interface-name</i></b> —Interface name of the control channel.                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li> <li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li> </ul> |

## convey-loss-threshold

|                                 |                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | convey-loss-threshold;                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> <b>continuity-check</b> ] |
| <b>Description</b>              | Enable loss-threshold-tlv transmission.                                                                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                           |

## cross-connect-ccm

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | cross-connect-ccm;                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> event ais-trigger-condition]                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                    |
| <b>Description</b>              | Configure the defect condition that raises an alarm indication signal when any cross-connect continuity check messages (CCMs) are received by the MEP.                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul> |

## cycle-time

---

|                                 |                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | cycle-time <i>cycle-time-value</i> ;                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</a> <i>profile-name</i> ]                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                             |
| <b>Description</b>              | Configure the time (in milliseconds) taken between back-to-back transmissions of SLA frames for a single connection.                                                                                |
| <b>Options</b>                  | <b><i>cycle-time-value</i></b> —Cycle time value in milliseconds.<br><b>Range:</b> 10 through 3,600,000<br><b>Default:</b> 1000                                                                     |
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li></ul> |

## data-channel

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | data-channel {<br>vlan <i>number</i> ;<br>}                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.2.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | For Ethernet ring protection, configure a data channel to define a set of VLAN IDs that belong to a ring instance.<br><br>VLANs specified in the data channel use the same topology used by the ERPS PDU in the control channel. Therefore, if a ring interface is blocked in the control channel, all traffic in the data channel is also blocked on that interface.                                                                                                                                              |
| <b>Options</b>                  | <b>vlan <i>number</i></b> —Specify (by VLAN ID) one or more VLANs that belong to a ring instance.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739</a></li> <li>• <a href="#">Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 746</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul> |

## data-tlv-size

---

|                     |                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax              | <code>data-tlv-size size;</code>                                                                                                                                                                                                                                                                                                                                 |
| Hierarchy Level     | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">maintenance-domain</a> <i>md-name</i> <a href="#">maintenance-association</a> <i>ma-name</i> <a href="#">mep</a> <i>mep-id</i> <a href="#">remote-mep</a> <i>remote-mep-id</i> <a href="#">sla-iterator-profile</a> <i>profile-name</i> ] |
| Release Information | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                   |
| Description         | Configure the size of the data TLV portion of the Y.1731 data frame.                                                                                                                                                                                                                                                                                             |
| Options             | <i>size</i> —Size of the data TLV portion of the Y.1731 data frame.                                                                                                                                                                                                                                                                                              |



**NOTE:** This option is applicable only for two-way delay measurement.

---

**Range:** 1 through 1400 bytes

**Default:** 1

|                          |                                                                                                                                                                                             |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Required Privilege Level | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                              |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">sla-iterator-profile on page 1184</a></li><li>• <a href="#">Configuring a Remote MEP with an Iterator Profile on page 662</a></li></ul> |

---

## default-actions

---

|                                 |                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>default-actions {<br/>    interface-down;<br/>}</pre>                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet <a href="#">connectivity-fault-management action-profile</a> <i>profile-name</i> ]                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                        |
| <b>Description</b>              | Define the action to be taken when connectivity to the remote MEP is lost.                                                                           |
| <b>Default</b>                  | If no action is configured, no action is taken.                                                                                                      |
| <b>Options</b>                  | <b>interface-down</b> —When a remote MEP connectivity failure is detected, bring the interface down.                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538</a></li></ul> |

## delay

---

|                            |                                                                                                                                                                                  |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>delay <i>delay-value</i>;</code>                                                                                                                                           |
| <b>Hierarchy Level</b>     | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</a> <i>profile-name</i> <a href="#">calculation-weight</a> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                          |
| <b>Description</b>         | Configure the calculation weight for delay.                                                                                                                                      |
| <b>Options</b>             | <i>delay-value</i> —Calculation weight for delay.                                                                                                                                |



**NOTE:** This option is applicable only for two-way delay measurement.

---

**Range:** 1 through 65,535

**Default:** 1

|                                 |                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li><li>• <a href="#">calculation-weight on page 903</a></li></ul> |

## delay (PPPoE Service Name Tables)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>delay seconds;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i> ],<br>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b><br><i>aci circuit-id-string ari remote-id-string</i> ]                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Support at [edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i><br><b>agent-specifier</b> <i>aci circuit-id-string ari remote-id-string</i> ] hierarchy level introduced in Junos<br>OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | <p>Configure the PPPoE underlying interface on the router to wait a specified number of seconds after receiving a PPPoE Active Discovery Initiation (PADI) control packet from a PPPoE client before sending a PPPoE Active Discovery Offer (PADO) packet to indicate that it can service the client request</p> <p>The router (PPPoE server) does not check whether another server has already sent a PADO packet during the delay period in response to the PPPoE client's PADI packet. It is up to the PPPoE client to determine whether another PPPoE server has responded to its PADI request, or if it must respond to the delayed PADO packet to establish a PPPoE session.</p> |
| <b>Options</b>                  | <p><b>seconds</b>—Number of seconds that the PPPoE underlying interface waits after receiving a PADI packet from a PPPoE client before sending a PADO packet in response.</p> <p><b>Range:</b> 1 through 120 seconds</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Configuring PPPoE Service Name Tables</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## delegate-server-processing

---

|                          |                                                                                                                                                                                                          |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | delegate-server-processing;                                                                                                                                                                              |
| Hierarchy Level          | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring</a> ]                                                                                                      |
| Release Information      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                           |
| Description              | <p>For Ethernet interfaces on MX Series routers , enable server-side processing for two-way delay measurement and loss measurement.</p> <p>By default, the processing is done by the Routing Engine.</p> |
| Required Privilege Level | trace—To view this statement in the configuration.<br>trace-control—To add this statement to the configuration.                                                                                          |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Frame Delay Measurements Overview on page 622</a></li></ul>                                                                                 |

## delay-variation

---

|                     |                                                                                                                                                           |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax              | delay-variation <i>delay-variation-value</i> ;                                                                                                            |
| Hierarchy Level     | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name calculation-weight</a> ] |
| Release Information | Statement introduced in Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                   |
| Description         | Configure the calculation weight for delay variation.                                                                                                     |
| Options             | <i>delay-variation-value</i> —Calculation weight for delay variation.                                                                                     |



**NOTE:** This option is applicable only for two-way delay measurement.

---

**Range:** 1 through 65,535

**Default:** 1

|                          |                                                                                                                                                                                                                                                              |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Required Privilege Level | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                               |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li><li>• <a href="#">calculation-weight on page 903</a></li></ul> |



## destination (IPCP)


|                                 |                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>destination address destination-profile <i>profile-name</i>;</code>                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet unnumbered-address <i>interface-name</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet unnumbered-address <i>interface-name</i> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                          |
| <b>Description</b>              | For unnumbered interfaces with PPP encapsulation, specify the IP address of the remote interface.                                                                                                                                                                                                          |
| <b>Options</b>                  | <b>address</b> —IP address of the remote interface.<br><br>The remaining statement is explained separately.                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring IPCP Options for Interfaces with PPP Encapsulation</i></li> <li>• <a href="#">address on page 863</a></li> <li>• <a href="#">negotiate-address on page 1078</a></li> <li>• <i>Junos OS Administration Library for Routing Devices</i></li> </ul>   |

## detect-loc

|                                 |                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>detect-loc;</code>                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols oam <a href="#">ethernet connectivity-fault-management maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> mep <i>mep-id</i> remote-mep <i>mep-id</i></a> ]      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                        |
| <b>Description</b>              | Specify whether Ethernet OAM continuity checks are performed for an individual remote maintenance end point (MEP).                                                                                    |
| <b>Default</b>                  | The MEP does not generate loss-of-continuity (LOC) defect messages by default.                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> <li>• <a href="#">remote-mep on page 1153</a></li> </ul> |

## device-count

---


|                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                  | <code>device-count <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                         | [edit chassis <a href="#">aggregated-devices ethernet</a> ]<br>[edit chassis <a href="#">aggregated-devices sonet</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                     | Statement introduced before Junos OS Release 7.4.<br>Statement functionality updated in Junos OS Release 14.2, as described below.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                             | <p>Configure the number of aggregated logical devices available to the router.</p> <p>Starting in Junos release 14.2, for MX series routers, aggregate Ethernet interfaces created under a logical system can be individually named. Prior to 14.2, ae interfaces were named automatically (AE1, AE2) etc. upon setting the device count. This change allows administrators to use custom naming schemes. System resources are only allocated for named ae interfaces, regardless of how many were declared in the device count. (In Junos 14.2 and earlier, ae naming occurred automatically up to the number specified for device count, and system resources were allocated whether a given ae interface was used or not.)</p> |
| <b>Options</b>                                                                                                                                                                                                                                                                                                                                                                                 | <i>number</i> —Set the number of aggregated logical devices that will be available for configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <div> <b>NOTE:</b> Starting with Junos OS Release 13.2, a maximum of 64 aggregated interfaces are supported for link aggregation of SONET/SDH interfaces. In releases before Junos OS Release 13.2, a maximum of 16 aggregated interfaces are supported for link aggregation of SONET/SDH interfaces.</div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <div><b>Range:</b> 1 - 496. The upper limit for this value is system specific.</div>                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"><li>• <a href="#">Configuring Junos OS for Supporting Aggregated Devices on page 140</a></li><li>• <a href="#">Configuring Aggregated SONET/SDH Interfaces</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## direction (MX Series)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | direction (inbound   outbound);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | <p>Configure whether the secure channel applies MACsec security to traffic entering or leaving an interface.</p> <p>If you need to apply MACsec on traffic entering and leaving an interface, you need to create one secure channel to apply MACsec on incoming traffic and another secure channel to apply MACsec on outgoing traffic within the same connectivity association. When you associate the connectivity association with an interface, MACsec is applied on traffic entering and leaving that interface.</p> <p>You only use this configuration option when you are configuring MACsec using static secure association keys (SAK) security mode. When you are configuring MACsec using static connectivity association keys (CAK) security mode, two secure channels that are not user-configurable—one inbound secure channel and one outbound secure channel—are automatically created within the connectivity association.</p> |
| <b>Default</b>                  | <p>This statement does not have a default value.</p> <p>If you have configured a secure channel to enable MACsec using static SAK security mode, you must specify whether the secure channel applies MACsec to traffic entering or leaving an interface. A candidate configuration that contains a secure channel that has not configured a direction cannot be committed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <p><b>inbound</b>—Enable MACsec security on traffic entering the interface that has applied the secure channel.</p> <p><b>outbound</b>—Enable MACsec security on traffic leaving the interface that has applied the secure channel.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## direction

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | direction (up   down);                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management</a> maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> <a href="#">mep mep-id</a> ]                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | Configure the direction of the MEP.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <b>up</b> —An UP MEP CCM is transmitted out of every logical interface which is part of the same bridging or vpls instance except for the interface configured on this MEP.<br><br>.....<br> <b>NOTE:</b> The up direction for MEP is not supported on T Series routers.<br>.....<br><b>down</b> —Down MEP CCMs are transmitted only out the interface configured on this MEP. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li><li>• <a href="#">IEEE 802.1ag OAM Connectivity Fault Management Overview on page 519</a></li></ul>                                                                                                                                                                                                                  |

## disable

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | disable;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit protocols <a href="#">lldp interface</a> (all   <i>interface-name</i> )],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp interface</a> (all   <i>interface-name</i> )]                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Disable LLDP globally or on an interface.</p> <p>For information about interface names, see <i>Interface Naming Overview</i>. For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i>. For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i>.</p> <p>For information about extended port names in the Junos Fusion technology, see <i>Understanding Junos Fusion Ports</i>.</p> |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring LLDP on page 316</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                    |

## disable (Link Protection)

|                                 |                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | disable;                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces aeX aggregated-ether-options lacp link-protection]                                                                                                                                                                               |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 9.3.</p> <p>Statement introduced in Junos OS Release 11.4 for EX Series switches.</p>                                                                                                                 |
| <b>Description</b>              | Disable LACP link protection on the interface.                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring LACP for Aggregated Ethernet Interfaces on page 148</a></li> <li>• <a href="#">Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</a></li> </ul> |

## disable (802.1X for MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | disable;                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ]) dot1x]                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.             |
| <b>Description</b>              | Disable 802.1X authentication on a specified interface or all interfaces.                                           |
| <b>Default</b>                  | 802.1X authentication is disabled on all interfaces.                                                                |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |

## dot1p-priority

---

|                                 |                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | dot1p-priority <i>number</i> ;                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                     |
| <b>Description</b>              | Specify the IEEE 802.1p priority to be used in the transmitted RAPS protocol data units.                                                                                                                           |
| <b>Options</b>                  | <i>number</i> —802.1p priority number.<br><b>Range:</b> 0 through 7<br><b>Default:</b> 0                                                                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li></ul> |

## dot1x

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>dot1x {   authenticator {     authentication-profile-name <i>access-profile-name</i>;     interface <i>interface-id</i> {       maximum-requests <i>integer</i>;       quiet-period <i>seconds</i>;       reauthentication (disable   interval <i>seconds</i>);       retries <i>integer</i>;       server-timeout <i>seconds</i>;       supplicant (<i>single</i>);       supplicant-timeout <i>seconds</i>;       transmit-period <i>seconds</i>;     }   } }</pre> |
| <b>Hierarchy Level</b>          | [edit protocols]                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | <p>For the MX Series only, specifies settings for using 802.1x Port-Based Network Access Control.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authenticator on page 881</a></li> <li>• <a href="#">authentication-profile-name on page 880</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> </ul>                                                                                                                                              |

## dot1x (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>dot1x {   disable;   guest-vlan (vlan-id   vlan-name);   mac-radius {     flap-on-disconnect;     restrict;   }   maximum-requests number;   no-reauthentication;   server-fail (deny   permit   use-cache   vlan-id   vlan-name);   server-reject-vlan (vlan-id   vlan-name) {     eapol-block;     block-interval block-interval;   }   supplicant-timeout seconds;   transmit-period seconds; }</pre> |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ])]                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Configure 802.1X authentication for Port-Based Network Access Control. 802.1X authentication is supported on interfaces that are members of private VLANs (PVLANS).</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                          |
| <b>Default</b>                  | 802.1X is disabled.                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                           |



## domain-id

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>domain-id <i>domain-id</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | <code>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols (ospf   ospf3)],</code><br><code>[edit routing-instances <i>routing-instance-name</i> protocols (ospf   ospf3)]</code>                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Specify a domain ID for a route. The domain ID identifies the OSPF domain from which the route originated.                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <b><i>domain-id</i></b> —You can specify either an IP address or an IP address and a local identifier using the following format: <i>ip-address:local-identifier</i> . If you do not specify a local identifier with the IP address, the identifier is assumed to have a value of 0.<br><b>Default:</b> If the router ID is not configured in the routing instance, the router ID is derived from an interface address belonging to the routing instance. |
| <b>Required Privilege Level</b> | <code>routing</code> —To view this statement in the configuration.<br><code>routing-control</code> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring Routing Between PE and CE Routers in Layer 3 VPNs</i></li> </ul>                                                                                                                                                                                                                                                                                                                                  |

## drop (PPPoE Service Name Tables)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>drop;</code>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | <code>[edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i>],</code><br><code>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b> <i>aci circuit-id-string</i> <i>ari remote-id-string</i>]</code>                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Support at <code>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b> <i>aci circuit-id-string</i> <i>ari remote-id-string</i>]</code> hierarchy level introduced in Junos OS Release 10.2.                                                                                                                                  |
| <b>Description</b>              | Direct the router to drop (ignore) a PPPoE Active Discovery Initiation (PADI) control packet received from a PPPoE client that contains the specified service name tag or agent circuit identifier/agent remote identifier (ACI/ARI) information. This action effectively denies the client's request to provide the specified service, or to accept requests from the subscriber or subscribers represented by the ACI/ARI information. |
| <b>Required Privilege Level</b> | <code>interface</code> —To view this statement in the configuration.<br><code>interface-control</code> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring PPPoE Service Name Tables</i></li> </ul>                                                                                                                                                                                                                                                                                                                                         |

## dynamic-profile (PPPoE Service Name Tables)

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <code>dynamic-profile <i>profile-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Hierarchy Level          | <code>[edit protocols pppoe service-name-tables <i>table-name</i> <i>service</i> <i>service-name</i>],</code><br><code>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <i>agent-specifier</i></code><br><code>aci <i>circuit-id-string</i> ari <i>remote-id-string</i>]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Release Information      | Statement introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description              | <p>Specify a dynamic profile to instantiate a dynamic PPPoE interface. You can associate a dynamic profile with a named service entry, <b>empty</b> service entry, or <b>any</b> service entry configured in a PPPoE service name table, or with an agent circuit identifier/agent remote identifier (ACI/ARI) pair defined for these services.</p> <p>The dynamic profile associated with a service entry in a PPPoE service name table overrides the dynamic profile associated with the PPPoE underlying interface on which the dynamic PPPoE interface is created.</p> <p>If you include the <b>dynamic-profile</b> statement at the <code>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <i>agent-specifier</i> aci <i>circuit-id-string</i> ari <i>remote-id-string</i>]</code> hierarchy level, you cannot also include the <b>static-interface</b> statement at this level. The <b>dynamic-profile</b> and <b>static-interface</b> statements are mutually exclusive for ACI/ARI pair configurations.</p> |
| Options                  | <b><i>profile-name</i></b> —Name of the dynamic profile that the router uses to instantiate a dynamic PPPoE interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Related Documentation    | <ul style="list-style-type: none"><li>• <i>Configuring PPPoE Service Name Tables</i></li><li>• <i>Assigning a Dynamic Profile and Routing Instance to a Service Name or ACI/ARI Pair for Dynamic PPPoE Interface Creation</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## east-interface

**Syntax**

```
east-interface {
  node-id mac-address;
  control-channel channel-name {
    vlan number;
    interface name interface-name
  }
  interface-none
  ring-protection-link-end;
}
```

**Hierarchy Level** [edit protocols [protection-group ethernet-ring ring-name](#)]

**Release Information** Statement introduced in Junos OS Release 9.4.  
Statement introduced in Junos OS Release 12.1 for EX Series switches.  
Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.

**Description** Define one of the two interface ports for Ethernet ring protection, the other being defined by the **west-interface** statement at the same hierarchy level. The interface must use the control channel's logical interface name. The control channel is a dedicated VLAN channel for the ring port.

EX Series switches do not use the node-id statement--the node ID is automatically configured on the switches using the MAC address.



**NOTE:** Always configure this port first, before configuring the **west-interface** statement.



**NOTE:** The Node ID is not configurable on EX Series switches. The node ID is automatically configured using the MAC address.

The statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**


- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739](#)
- [west-interface on page 1257](#)
- [ethernet-ring on page 954](#)
- [Example: Configuring Ethernet Ring Protection Switching on EX Series Switches](#)

- *Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS*
- *Configuring Ethernet Ring Protection Switching (CLI Procedure)*

---

## egress-policer-overhead

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>egress-policer-overhead bytes;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | <code>[edit chassis fpc slot-number pic pic-number]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Add the specified number of bytes to the actual length of an Ethernet frame when determining the actions of Layer 2 policers, MAC policers, or queue rate limits applied to output traffic on the line card. You can configure egress policer overhead to account for egress <i>shaping</i> overhead bytes added to output traffic on the line card.</p> <p>On M Series and T Series routers, this statement is supported on Gigabit Ethernet Intelligent Queuing 2 (IQ2) PICs and Enhanced IQ2 (IQ2E) PICs. On MX Series routers, this statement is supported for interfaces configured on Dense Port Concentrators (DPCs).</p> |
|                                 | <div> <b>NOTE:</b> This statement is not supported on Modular Interface Cards (MICs) or Modular Port Concentrators (MPCs) in MX Series routers.</div>                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <p><b>bytes</b>—Number of bytes added to a packet exiting an interface.</p> <p><b>Range:</b> 0–255 bytes</p> <p><b>Default:</b> 0</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>egress-shaping-overhead</i></li><li>• <i>Policer Overhead to Account for Rate Shaping Overview</i></li><li>• <i>Example: Configuring Policer Overhead to Account for Rate Shaping</i></li><li>• <i>Configuring a Policer Overhead</i></li><li>• <i>CoS on Enhanced IQ2 PICs Overview</i></li></ul>                                                                                                                                                                                                                                                                                       |

## encapsulation (Logical Interface)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | encapsulation (atm-ccc-cell-relay   atm-ccc-vc-mux   atm-cisco-nlpid   atm-mlppp-llc   atm-nlpid   atm-ppp-llc   atm-ppp-vc-mux   atm-snap   atm-tcc-snap   atm-tcc-vc-mux   atm-vc-mux   ether-over-atm-llc   ether-vpls-over-atm-llc   ether-vpls-over-fr   ether-vpls-over-ppp   ethernet   ethernet-ccc   ethernet-vpls   ethernet-vpls-fr   frame-relay-ccc   frame-relay-ether-type   frame-relay-ether-type-tcc   frame-relay-ppp   frame-relay-tcc   gre-fragmentation   multilink-frame-relay-end-to-end   multilink-ppp   ppp-over-ether   ppp-over-ether-over-atm-llc   vlan-bridge   vlan-ccc   vlan-vci-ccc   vlan-tcc   vlan-vpls   vxlan);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit interfaces <i>rlsq number</i> <b>unit</b> <i>logical-unit-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers ( <b>ethernet</b> , <b>vlan-ccc</b> , and <b>vlan-tcc</b> options only).<br>Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Access Routers. Only the <b>atm-ccc-cell-relay</b> and <b>atm-ccc-vc-mux</b> options are supported on ACX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>         | Configure a logical link-layer encapsulation type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>             | <p><b>atm-ccc-cell-relay</b>—Use ATM cell-relay encapsulation.</p> <p><b>atm-ccc-vc-mux</b>—Use ATM virtual circuit (VC) multiplex encapsulation on CCC circuits. When you use this encapsulation type, you can configure the <b>ccc</b> family only.</p> <p><b>atm-cisco-nlpid</b>—Use Cisco ATM network layer protocol identifier (NLPID) encapsulation. When you use this encapsulation type, you can configure the <b>inet</b> family only.</p> <p><b>atm-mlppp-llc</b>—For ATM2 IQ interfaces only, use Multilink Point-to-Point (MLPPP) over AAL5 LLC. For this encapsulation type, your router must be equipped with a Link Services or Voice Services PIC. MLPPP over ATM encapsulation is not supported on ATM2 IQ OC48 interfaces.</p> <p><b>atm-nlpid</b>—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the <b>inet</b> family only.</p> <p><b>atm-ppp-llc</b>—(ATM2 IQ interfaces and MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP only) Use PPP over AAL5 LLC encapsulation.</p> <p><b>atm-ppp-vc-mux</b>—(ATM2 IQ interfaces and MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP only) Use PPP over ATM AAL5 multiplex encapsulation.</p> <p><b>atm-snap</b>—(All interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) Use ATM subnetwork attachment point (SNAP) encapsulation.</p> <p><b>atm-tcc-snap</b>—Use ATM SNAP encapsulation on translational cross-connect (TCC) circuits.</p> |

**atm-tcc-vc-mux**—Use ATM VC multiplex encapsulation on TCC circuits. When you use this encapsulation type, you can configure the **tcc** family only.

**atm-vc-mux**—(All interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) Use ATM VC multiplex encapsulation. When you use this encapsulation type, you can configure the **inet** family only.

**ether-over-atm-llc**—(All IP interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) For interfaces that carry IP traffic, use Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces.

**ether-vpls-over-atm-llc**—For ATM2 IQ interfaces only, use the Ethernet virtual private LAN service (VPLS) over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the frame check sequence (FCS) field removed.

**ether-vpls-over-fr**—For E1, T1, E3, T3, and SONET interfaces only, use the Ethernet virtual private LAN service (VPLS) over Frame Relay encapsulation to support Bridged Ethernet over Frame Relay encapsulated TDM interfaces for VPLS applications, per RFC 2427, *Multiprotocol Interconnect over Frame Relay*.



**NOTE:** The SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP, the Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP, and the DS3/E3 MIC do not support Ethernet over Frame Relay encapsulation.

---

**ether-vpls-over-ppp**—For E1, T1, E3, T3, and SONET interfaces only, use the Ethernet virtual private LAN service (VPLS) over Point-to-Point Protocol (PPP) encapsulation to support Bridged Ethernet over PPP-encapsulated TDM interfaces for VPLS applications.

**ethernet**—Use Ethernet II encapsulation (as described in RFC 894, *A Standard for the Transmission of IP Datagrams over Ethernet Networks*).

**ethernet-ccc**—Use Ethernet CCC encapsulation on Ethernet interfaces.

**ethernet-vpls**—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard Tag Protocol ID (TPID) values.



**NOTE:** The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

---

**ethernet-vpls-fr**—Use in a VPLS setup when a CE device is connected to a PE device over a time-division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer layer 2 Frame Relay connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use the MAC address to forward the packet into a given VPLS instance.

**frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**frame-relay-ether-type**—Use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. The physical interface must be configured with flexible-frame-relay encapsulation.

**frame-relay-ether-type-tcc**—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect different media. The physical interface must be configured with flexible-frame-relay encapsulation.

**frame-relay-ppp**—Use PPP over Frame Relay circuits. When you use this encapsulation type, you can configure the **ppp** family only.

**frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits for connecting different media. When you use this encapsulation type, you can configure the **tcc** family only.

**gre-fragmentation**—For adaptive services interfaces only, use GRE fragmentation encapsulation to enable fragmentation of IPv4 packets in GRE tunnels. This encapsulation clears the do not fragment (DF) bit in the packet header. If the packet's size exceeds the tunnel's maximum transmission unit (MTU) value, the packet is fragmented before encapsulation.

**multilink-frame-relay-end-to-end**—Use MLFR FRF.15 encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces, and is supported on LSQ and redundant LSQ interfaces.

**multilink-ppp**—Use MLPPP encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces.

**ppp-over-ether**—You use PPP over Ethernet encapsulation to configure an underlying Ethernet interface for a dynamic PPPoE logical interface.

**ppp-over-ether-over-atm-llc**—(MX Series routers with MPCs using the ATM MIC with SFP only) For underlying ATM interfaces, use PPP over Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, configure the interface address on the PPP interface.

**vlan-bridge**—Use Ethernet VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q tagging, flexible-ethernet-services, and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

**vlan-ccc**—Use Ethernet virtual LAN (VLAN) encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**vlan-vci-ccc**—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**vlan-tcc**—Use Ethernet VLAN encapsulation on TCC circuits. When you use this encapsulation type, you can configure the **tcc** family only.

**vlan-vpls**—Use Ethernet VLAN encapsulation on VPLS circuits.

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|

**Related Documentation**

- *Configuring Layer 2 Switching Cross-Connects Using CCC*
- *Configuring the Encapsulation for Layer 2 Switching TCCs*
- *Configuring Interface Encapsulation on Logical Interfaces*
- *Configuring MPLS LSP Tunnel Cross-Connects Using CCC*
- *Circuit and Translational Cross-Connects Overview*
- [Identifying the Access Concentrator on page 331](#)
- *Configuring ATM Interface Encapsulation*
- [Configuring VLAN and Extended VLAN Encapsulation on page 247](#)
- *Configuring ATM-to-Ethernet Interworking*
- *Configuring Interface Encapsulation on PTX Series Packet Transport Routers*
- *Configuring CCC Encapsulation for Layer 2 VPNs*
- *Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits*
- *Configuring ATM for Subscriber Access*
- *CoS on ATM IMA Pseudowire Interfaces Overview*
- *Configuring Policing on an ATM IMA Pseudowire*



## encapsulation (Physical Interface)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | encapsulation (atm-ccc-cell-relay   atm-pvc   cisco-hdlc   cisco-hdlc-ccc   cisco-hdlc-tcc   ethernet-bridge   ethernet-ccc   ethernet-over-atm   ethernet-tcc   ethernet-vpls   ethernet-vpls-fr   ether-vpls-over-atm-llc   ethernet-vpls-ppp   extended-frame-relay-ccc   extended-frame-relay-ether-type-tcc   extended-frame-relay-tcc   extended-vlan-bridge   extended-vlan-ccc   extended-vlan-tcc   extended-vlan-vpls   flexible-ethernet-services   flexible-frame-relay   frame-relay   frame-relay-ccc   frame-relay-ether-type   frame-relay-ether-type-tcc   frame-relay-port-ccc   frame-relay-tcc   generic-services   multilink-frame-relay-uni-nni   ppp   ppp-ccc   ppp-tcc   vlan-ccc   vlan-vci-ccc   vlan-vpls);                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> ],<br>[edit interfaces rlsq <i>number:number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for EX Series switches.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers ( <b>flexible-ethernet-services</b> , <b>ethernet-ccc</b> , and <b>ethernet-tcc</b> options only).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>         | Specify the physical link-layer encapsulation type. Not all encapsulation types are supported on the switches. See the switch CLI.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Default</b>             | For SONET interfaces— <b>ppp</b><br><br>For ATM interfaces— <b>atm-pvc</b><br><br>For DS1, E1, and T1 interfaces— <b>ppp</b><br><br>For DS3, E3, and T3 interfaces— <b>ppp</b><br><br>For all channelized interfaces— <b>ppp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>             | <b>atm-ccc-cell-relay</b> —Use ATM cell-relay encapsulation.<br><br><b>atm-pvc</b> —Use ATM PVC encapsulation.<br><br><b>cisco-hdlc</b> —Use Cisco-compatible High-Level Data Link Control (HDLC) framing.<br><br><b>cisco-hdlc-ccc</b> —Use Cisco-compatible HDLC framing on CCC circuits.<br><br><b>cisco-hdlc-tcc</b> —Use Cisco-compatible HDLC framing on TCC circuits for connecting different media.<br><br><b>ethernet-bridge</b> —Use Ethernet bridge encapsulation on Ethernet interfaces that have bridging enabled and that must accept all packets.<br><br><b>ethernet-ccc</b> —Use Ethernet CCC encapsulation on Ethernet interfaces that must accept packets carrying standard Tag Protocol ID (TPID) values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, CCC is not supported.<br><br><b>ethernet-over-atm</b> —For interfaces that carry IPv4 traffic, use Ethernet over ATM encapsulation. When you use this encapsulation type, you cannot configure multipoint |

interfaces. As defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*, this encapsulation type allows ATM interfaces to connect to devices that support only bridge protocol data units (BPDUs). Junos OS does not completely support bridging, but accepts BPDU packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet LLC/SNAP frames with IP or ARP in the payload, and drops the rest. For packets destined to the Ethernet LAN, a route lookup is done using the destination IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and MAC header, and the packet is forwarded to the ATM interface.

**ethernet-tcc**—For interfaces that carry IPv4 traffic, use Ethernet TCC encapsulation on interfaces that must accept packets carrying standard TPID values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC is not supported.

**ethernet-vpls**—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard TPID values. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.

**ethernet-vpls-fr**—Use in a VPLS setup when a CE device is connected to a PE device over a time division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer Layer 2 Frame Relay connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use the MAC address to forward the packet into a given VPLS instance.

**ethernet-vpls-ppp**—Use in a VPLS setup when a CE device is connected to a PE device over a time division multiplexing (TDM) link. This encapsulation type enables the PE device to terminate the outer Layer 2 PPP connection, use the 802.1p bits inside the inner Ethernet header to classify the packets, look at the MAC address from the Ethernet header, and use it to forward the packet into a given VPLS instance.

**ether-vpls-over-atm-llc**—For ATM intelligent queuing (IQ) interfaces only, use the Ethernet virtual private LAN service (VPLS) over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the frame check sequence (FCS) field removed.

**extended-frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC.

**extended-frame-relay-ether-type-tcc**—Use extended Frame Relay ether type TCC for Cisco-compatible Frame Relay for DLCIs 1 through 1022. This encapsulation type is used for circuits with different media on either side of the connection.

**extended-frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits to connect different media. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC.

**extended-vlan-bridge**—Use extended VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q VLAN tagging and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

**extended-vlan-ccc**—Use extended VLAN encapsulation on CCC circuits with Gigabit Ethernet and 4-port Fast Ethernet interfaces that must accept packets carrying 802.1Q values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, extended VLAN CCC is not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC is not supported.

**extended-vlan-tcc**—For interfaces that carry IPv4 traffic, use extended VLAN encapsulation on TCC circuits with Gigabit Ethernet interfaces on which you want to use 802.1Q tagging. For 4-port Gigabit Ethernet PICs, extended VLAN TCC is not supported.

**extended-vlan-vpls**—Use extended VLAN VPLS encapsulation on Ethernet interfaces that have VLAN 802.1Q tagging and VPLS enabled and that must accept packets carrying TPIDs 0x8100, 0x9100, and 0x9901. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.



**NOTE:** The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

**flexible-ethernet-services**—For Gigabit Ethernet IQ interfaces and Gigabit Ethernet PICs with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), use flexible Ethernet services encapsulation when you want to configure multiple per-unit Ethernet encapsulations. Aggregated Ethernet bundles can use this encapsulation type. This encapsulation type allows you to configure any combination of route, TCC, CCC, Layer 2 virtual private networks (VPNs), and VPLS encapsulations on a single physical port. If you configure flexible Ethernet services encapsulation on the physical interface, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

**flexible-frame-relay**—For IQ interfaces only, use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value from 1 through 1022.

**frame-relay**—Use Frame Relay encapsulation.

**frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits.

**frame-relay-ether-type**—Use Frame Relay ether type encapsulation for compatibility with the Cisco Frame Relay.

**frame-relay-ether-type-tcc**—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect different media.

**frame-relay-port-ccc**—Use Frame Relay port CCC encapsulation to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. When you use this encapsulation type, you can configure the **ccc** family only.

**frame-relay-tcc**—Use Frame Relay encapsulation on TCC circuits to connect different media.

**generic-services**—Use generic services encapsulation for services with a hierarchical scheduler.

**multilink-frame-relay-uni-nni**—Use MLFR UNI NNI encapsulation. This encapsulation is used on link services, voice services interfaces functioning as FRF.16 bundles, and their constituent T1 or E1 interfaces, and is supported on LSQ and redundant LSQ interfaces.

**ppp**—Use serial PPP encapsulation.

**ppp-ccc**—Use serial PPP encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only.

**ppp-tcc**—Use serial PPP encapsulation on TCC circuits for connecting different media. When you use this encapsulation type, you can configure the **tcc** family only.

**vlan-ccc**—Use Ethernet VLAN encapsulation on CCC circuits.

**vlan-vci-ccc**—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the **ccc** family only. All logical interfaces configured on the Ethernet interface must also have the encapsulation type set to **vlan-vci-ccc**.

**vlan-vpls**—Use VLAN VPLS encapsulation on Ethernet interfaces with VLAN tagging and VPLS enabled. Interfaces with VLAN VPLS encapsulation accept packets carrying standard TPID values only. On M Series routers, except the M320 router, the 4-port Fast Ethernet TX PIC and the 1-port, 2-port, and 4-port, 4-slot Gigabit Ethernet PICs can use the Ethernet VPLS encapsulation type.



**NOTE:**

- Label-switched interfaces (LSIs) do not support VLAN VPLS encapsulation. Therefore, you can only use VLAN VPLS encapsulation on a PE-router-to-CE-router interface and not a core-facing interface.
  - Starting with Junos OS release 13.3, a commit error occurs when you configure **vlan-vpls** encapsulation on a physical interface and configure family **inet** on one of the logical units. Previously, it was possible to commit this invalid configuration.
- 

|                           |                                                               |
|---------------------------|---------------------------------------------------------------|
| <b>Required Privilege</b> | interface—To view this statement in the configuration.        |
| <b>Level</b>              | interface-control—To add this statement to the configuration. |

**Related  
Documentation**

- *Configuring Interface Encapsulation on Physical Interfaces*
- *Configuring CCC Encapsulation for Layer 2 VPNs*
- *Configuring Layer 2 Switching Cross-Connects Using CCC*
- *Configuring TCC Encapsulation for Layer 2 VPNs and Layer 2 Circuits*
- *Configuring ATM Interface Encapsulation*
- *Configuring ATM-to-Ethernet Interworking*
- [Configuring VLAN and Extended VLAN Encapsulation on page 247](#)
- *OBSOLETE: Configuring Extended VLAN Encapsulation*
- *Configuring Encapsulation for Layer 2 Wholesale VLAN Interfaces*
- *Configuring Interfaces for Layer 2 Circuits*
- *Configuring Interface Encapsulation on PTX Series Packet Transport Routers*
- *Configuring MPLS LSP Tunnel Cross-Connects Using CCC*
- *Configuring TCC*
- *Configuring VPLS Interface Encapsulation*
- *Configuring Interfaces for VPLS Routing*
- *Defining the Encapsulation for Switching Cross-Connects*

## encryption (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | encryption;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Enable MACsec encryption within a secure channel.</p> <p>You can enable MACsec without enabling encryption. If a connectivity association with a secure channel that has not enabled MACsec encryption is associated with an interface, traffic is forwarded across the Ethernet link in clear text. You are, therefore, able to view this unencrypted traffic when you are monitoring the link. The MACsec header is still applied to the frame, however, and all MACsec data integrity checks are run on both ends of the link to ensure the traffic has not been tampered with and does not represent a security threat.</p> <p>Traffic traversing a MAC-enabled point-to-point Ethernet link traverses the link at the same speed regardless of whether encryption is enabled or disabled. You cannot increase the speed of traffic traversing a MACsec-enabled Ethernet link by disabling encryption.</p> <p>This command is used to enable encryption when MACsec is configured using secure association key (SAK) security mode only. When MACsec is configuring using static connectivity association key (CAK) security mode, the encryption setting is configured outside of the secure channel using the <b>no-encryption</b> configuration statement.</p> |
| <b>Default</b>                  | MACsec encryption is disabled when MACsec is configured using static SAK security mode, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

---

## erroneous-ccm

---

|                                 |                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | erroneous-ccm;                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile<br><i>action-profile-name</i> event ais-trigger-condition]                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                            |
| <b>Description</b>              | Configure the defect condition that raises an alarm indication signal when any cross-connect continuity check messages (CCMs) with an unexpected MEP ID or an erroneous maintenance domain level are received by the MEP. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul>         |

## ether-options

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>ether-options {<br/>    802.3ad {<br/>        aex;<br/>        (backup   primary);<br/>        lacp {<br/>            force-up;<br/>            port-priority<br/>        }<br/>    }<br/>    (auto-negotiation   no-auto-negotiation);<br/>    ethernet-switch-profile {<br/>        tag-protocol-id;<br/>    }<br/>    (flow-control   no-flow-control);<br/>    ieee-802-3az-eee;<br/>    link-mode mode;<br/>    (loopback   no-loopback);<br/>    speed (speed   auto-negotiation);<br/>}</pre>         |
| <b>Hierarchy Level</b>          | <pre>[edit interfaces interface-name],<br/>[edit interfaces interface-range range]</pre>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 12.3R2.                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | <p>Configure Ethernet properties for a Gigabit Ethernet interface or a 10-Gigabit Ethernet interface.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring Gigabit Ethernet Interfaces (CLI Procedure)</i></li><li>• <i>Configuring Gigabit Ethernet Interfaces (CLI Procedure)</i></li><li>• <i>Configuring Gigabit Ethernet Interfaces (J-Web Procedure)</i></li><li>• <i>Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</i></li><li>• <i>Configuring Q-in-Q Tunneling (CLI Procedure)</i></li><li>• <a href="#">Junos OS Ethernet Interfaces Configuration Guide</a></li></ul> |



## ethernet (Chassis)

|                                 |                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>ethernet {<br/>    <b>device-count</b> <i>number</i>;<br/>    lacp {<br/>        link-protection {<br/>            non-revertive;<br/>        }<br/>        system-priority;<br/>    }<br/>}</pre>                                  |
| <b>Hierarchy Level</b>          | [edit chassis <b>aggregated-devices</b> ]                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                                                               |
| <b>Description</b>              | Configure properties for Ethernet aggregated devices on the router.                                                                                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Junos OS for Supporting Aggregated Devices on page 140</a></li><li>• <i>Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</i></li></ul> |

## ethernet (Protocols OAM)

```
Syntax ethernet {
    connectivity-fault-management {
        action-profile profile-name {
            default-actions {
                interface-down;
            }
        }
    }
    performance-monitoring {
        delegate-server-processing;
        hardware-assisted-timestamping;
        sla-iterator-profiles {
            profile-name {
                avg-fd-twoway-threshold;
                avg-ifdv-twoway-threshold;
                avg-flr-forward-threshold;
                avg-flr-backward-threshold;
                disable;
                calculation-weight {
                    delay delay-weight;
                    delay-variation delay-variation-weight;
                }
                cycle-time milliseconds;
                iteration-period connections;
                measurement-type (loss | statistical-frame-loss | two-way-delay);
            }
        }
    }
    linktrace {
        age (30m | 10m | 1m | 30s | 10s);
        path-database-size path-database-size;
    }
    maintenance-domain domain-name {
        level number;
        name-format (character-string | none | dns | mac+2octet);
        maintenance-association ma-name {
            short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
            protect-maintenance-association protect-ma-name;
            remote-maintenance-association remote-ma-name;
            continuity-check {
                convey-loss-threshold;
                hold-interval minutes;
                interface-status-tlv;
                interval (10m | 10s | 1m | 1s | 100ms);
                loss-threshold number;
                port-status-tlv;
            }
            mep mep-id {
                auto-discovery;
                direction (up | down);
                interface interface-name (protect | working);
                lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect |
                    rem-err-xcon | xcon );
            }
        }
    }
}
```



```
lmi {  
    status-counter count;  
    polling-verification-timer value;  
    interface name {  
        uni-id uni-name;  
        status-counter number;  
        polling-verification-timer value;  
        evc-map-type (all-to-one-bundling | bundling | service-multiplexing);  
        evc evc-name {  
            default-evc;  
            vlan-list vlan-id-list;  
        }  
    }  
}
```

**Hierarchy Level** [edit protocols [oam](#)]

**Release Information** Statement introduced in Junos OS Release 8.2.

**Description** For Ethernet interfaces on EX Series switches, and M320, MX Series, and T Series routers, provide fault signaling and detection for 802.3ah Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Enabling IEEE 802.3ah OAM Support on page 597](#)

## ethernet-policer-profile

```
Syntax ethernet-policer-profile {
    input-priority-map {
        ieee802.1p premium [ values ];
    }
    output-priority-map {
        classifier {
            premium {
                forwarding-class class-name {
                    loss-priority (high | low);
                }
            }
        }
    }
    policer cos-policer-name {
        aggregate {
            bandwidth-limit bps;
            burst-size-limit bytes;
        }
        premium {
            bandwidth-limit bps;
            burst-size-limit bytes;
        }
    }
}
```

**Hierarchy Level** [edit interfaces *interface-name* gigether-options [ethernet-switch-profile](#)],  
[edit interfaces *interface-name* aggregated-ether-options [ethernet-switch-profile](#)]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description**



**NOTE:** On QFX Series standalone switches, this statement hierarchy is only supported on the Enhanced Layer 2 Switching CLI.

For Gigabit Ethernet IQ, 10-Gigabit Ethernet, Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), and 100-Gigabit Ethernet Type 5 PIC with CFP, configure a class of service (CoS)-based policer. Policing applies to the inner VLAN identifiers, not to the outer tag. For Gigabit Ethernet interfaces with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), the **premium** policer is not supported.

The statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring Gigabit Ethernet Policers on page 465](#)

## ethernet-ring

---

**Syntax**    `ethernet-ring ring-name {  
                  control-vlan (vlan-id | vlan-name);  
                  data-channel {  
                    vlan number  
                  }  
                  east-interface {  
                    control-channel channel-name {  
                      vlan number;  
                      interface name interface-name  
                    }  
                  }  
                  guard-interval number;  
                  node-id mac-address;  
                  restore-interval number;  
                  ring-protection-link-owner;  
                  west-interface {  
                    control-channel channel-name {  
                      vlan number;  
                    }  
                  }  
                }`

**Hierarchy Level**    [edit protocols [protection-group](#)]

**Release Information**    Statement introduced in Junos OS Release 9.4.  
                              Statement introduced in Junos OS Release 12.1 for EX Series switches.  
                              Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.

**Description**    For Ethernet PICs on MX Series routers or for EX Series switches, , specify the Ethernet ring in an Ethernet ring protection switching configuration.

**Options**    *ring-name*—Name of the Ethernet protection ring.  
  
              The remaining statements are explained separately.

**Required Privilege Level**    interface—To view this statement in the configuration.  
                                  interface-control—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Ring Protection Switching Overview on page 213](#)
- *Example: Configuring Ethernet Ring Protection Switching on EX Series Switches*
- *Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS*
- *Configuring Ethernet Ring Protection Switching (CLI Procedure)*

## ethernet-switch-profile

**Syntax**

```
ethernet-switch-profile {
  ethernet-policer-profile {
    input-priority-map {
      ieee802.1p premium [values];
    }
    output-priority-map {
      classifier {
        premium {
          forwarding-class class-name {
            loss-priority (high | low);
          }
        }
      }
    }
  }
  policer cos-policer-name {
    aggregate {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
    premium {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
  }
  tag-protocol-id tpid;
}
mac-learn-enable;
```

**Hierarchy Level** [edit interfaces *interface-name* *gigether-options*],  
[edit interfaces *interface-name* *aggregated-ether-options*],  
[edit interfaces *interface-name* *aggregated-ether-options*],  
[edit interfaces *interface-name* *ether-options*]

**Release Information** Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.  
Statement introduced in Junos OS Release 13.2 for the QFX Series.  
Statement introduced in Junos OS Release 13.2X50-D15 for the EX Series switches.

**Description**



**NOTE:** On QFX Series standalone switches, the `ethernet-policer-profile` CLI hierarchy and the `mac-learn-enable` statement are supported only on the Enhanced Layer 2 Switching CLI.

For Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC, aggregated Ethernet with Gigabit Ethernet IQ interfaces, the built-in Gigabit Ethernet port on the M7i router); 100-Gigabit Ethernet Type 5 PIC with CFP; and Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit

Ethernet, and aggregated Ethernet interfaces on EX Series switches, configure VLAN tag and MAC address accounting and filtering properties.

The remaining statements are explained separately.



.....

**NOTE:** When you gather interfaces into a bridge domain, the `no-mac-learn-enable` statement at the `[edit interfaces interface-name together-options ethernet-switch-profile]` hierarchy level is not supported. You must use the `no-mac-learning` statement at the `[edit bridge-domains bridge-domain-name bridge-options interface interface-name]` hierarchy level to disable MAC learning on an interface in a bridge domain. For information on disabling MAC learning for a bridge domain, see the *MX Series Layer 2 Configuration Guide*.

.....

|                                 |                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Default</b>                  | If the <b>ethernet-switch-profile</b> statement is not configured, Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router) behave like Gigabit Ethernet interfaces.                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li><li>• <a href="#">Configuring MAC Address Filtering on page 465</a></li><li>• <a href="#">Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483</a></li><li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li></ul> |




## evcs

|                                 |                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>evcs evc-id {     evc-protocol cfm;     remote-uni-count count;     multipoint-to-multipoint; }</pre>                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet</a> ]                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.5.                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | On MX Series routers with <b>ge</b> , <b>xe</b> , or <b>ae</b> interfaces, configure an OAM Ethernet virtual connection.                                                                                                                                                                                                                                   |
| <b>Options</b>                  | <p><b>remote-uni-count <i>count</i></b>—(Optional) Specify the number of remote UNIs in the EVC configuration, the default is 1.</p> <p><b>multipoint-to-multipoint</b>—(Optional) Specify multiple points in the EVC configuration, the default is point-to-point if <b>remote-uni-count</b> is 1.</p> <p>Remaining options are explained separately.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Ethernet Local Management Interface on page 540</a></li> <li>• <a href="#">lmi (Ethernet OAM) on page 1034</a></li> </ul>                                                                                                                                                                 |

## evc-protocol cfm

---

|                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                                                                                                                                                                      | evc-protocol cfm {<br>maintenance-association <i>association-name</i>   vpls routing-instance <i>routing-id</i> ;<br>maintenance-domain <i>domain-id</i> ;<br>mep-id <i>mep-id</i> ;<br>}                                                                                                                                                                                                                           |
| Hierarchy Level                                                                                                                                                             | [edit protocols <a href="#">oam ethernet evcs</a> ]                                                                                                                                                                                                                                                                                                                                                                 |
| Release Information                                                                                                                                                         | Statement introduced in Junos OS Release 9.5.<br><b>mep-id mep-id</b> statement introduced in Junos OS Release 15.1.                                                                                                                                                                                                                                                                                                |
| Description                                                                                                                                                                 | Specify connectivity fault management (CFM) or virtual private LAN service (VPLS) as the Ethernet virtual connection (EVC) protocol.                                                                                                                                                                                                                                                                                |
| Options                                                                                                                                                                     | <b>management-domain domain-id</b> —(Optional) For CFM, specify the CFM management domain.<br><br><b>management-association association-id</b> —(Optional) For CFM, specify the CFM management association.<br><br><b>routing-instance instance-id</b> —(Optional) For VPLS, specify the VPLS routing instance.<br><br><b>mep-id mep-id</b> —(Required for CFM) Identifier for the maintenance association endpoint |
| <hr/> <div> <b>NOTE:</b> This option is available on MX Series routers only.</div> <hr/> |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Range:</b> 1 through 8191                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Required Privilege Level                                                                                                                                                    | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                             |
| Related Documentation                                                                                                                                                       | <ul style="list-style-type: none"><li>• <a href="#">Configuring Ethernet Local Management Interface on page 540</a></li><li>• <a href="#">lmi (Ethernet OAM) on page 1034</a></li></ul>                                                                                                                                                                                                                             |

## event (LFM)

|                                 |                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>event {   link-adjacency-loss;   link-event-rate {     frame-error count;     frame-period count;     frame-period-summary count;     symbol-period count;   }   protocol-down; }</pre> |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile</a> ]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                                |
| <b>Description</b>              | <p>Configure threshold values for link events in an action profile.</p> <p>The remaining statements are explained separately.</p>                                                            |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Monitoring Protocol Status on page 607</a></li> </ul>                                                                                   |

## event-thresholds

|                                 |                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>event-thresholds {   frame-error count;   frame-period count;   frame-period-summary count;   symbol-period count; }</pre>                     |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam link-fault-management interface interface-name</a> ]                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                       |
| <b>Description</b>              | <p>Configure threshold limit values for link events in periodic OAM PDUs.</p> <p>The remaining statements are explained separately.</p>             |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Threshold Values for Local Fault Events on an Interface on page 600</a></li> </ul> |

## exclude-protocol (MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>exclude-protocol <i>protocol-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit security macsec connectivity-association <i>connectivity-association-name</i>]</code>                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Specifies protocols whose packets are not secured using Media Access Control Security (MACsec) when MACsec is enabled on a link using static connectivity association key (CAK) security mode.</p> <p>When this option is enabled in a connectivity association that is attached to an interface, MACsec is not enabled for all packets of the specified protocols that are sent and received on the link.</p> |
| <b>Default</b>                  | <p>Disabled.</p> <p>All packets are secured on a link when MACsec is enabled, with the exception of all types of Spanning Tree Protocol (STP) packets.</p>                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <p><b><i>protocol-name</i></b>—Specifies the name of the protocol that should not be MACsec-secured. Options include:</p> <ul style="list-style-type: none"><li>• <b>cdp</b>—Cisco Discovery Protocol.</li><li>• <b>lACP</b>—Link Aggregation Control Protocol.</li><li>• <b>lldp</b>—Link Level Discovery Protocol.</li></ul>                                                                                    |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                              |

## exercise

---

|                                 |                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>request protection-group ethernet-aps exercise md &lt;md&gt; ma &lt;ma&gt;</code>                                            |
| <b>Hierarchy Level</b>          | <code>[edit protocols protection-group ethernet-aps]</code>                                                                        |
| <b>Description</b>              | This configuration statement is used to test if APS is operating correctly, it does not interrupt regular APS operations.          |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p> |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Automatic Protection Switching Overview on page 205</a></li></ul>     |

---

## failover-delay

---

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>failover-delay <i>milliseconds</i>;</code>                                                                    |
| <b>Hierarchy Level</b>          | [edit protocols vrrp]                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                       |
| <b>Description</b>              | Configure the failover delay for VRRP and VRRP for IPv6 operations.                                                 |
| <b>Options</b>                  | <i>milliseconds</i> —Specify the failover delay time, in milliseconds.<br><b>Range:</b> 50 through 2000             |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring VRRP and VRRP for IPv6 on page 324</a></li></ul>    |

## family

```

Syntax  family family {
        accounting {
            destination-class-usage;
            source-class-usage {
                (input | output | input output);
            }
        }
        access-concentrator name;
        address address {
            ... the address subhierarchy appears after the main [edit interfaces interface-name unit
                logical-unit-number family family-name] hierarchy ...
        }
        bundle interface-name;
        core-facing;
        demux-destination {
            destination-prefix;
        }
        demux-source {
            source-prefix;
        }
        direct-connect;
        duplicate-protection;
        dynamic-profile profile-name;
        filter {
            group filter-group-number;
            input filter-name;
            input-list [ filter-names ];
            output filter-name;
            output-list [ filter-names ];
        }
        interface-mode (access | trunk);
        ipsec-sa sa-name;
        keep-address-and-control;
        mac-validate (loose | strict);
        max-sessions number;
        max-sessions-vsa-ignore;
        mtu bytes;
        multicast-only;
        negotiate-address;
        no-redirects;
        policer {
            arp policer-template-name;
            input policer-template-name;
            output policer-template-name;
        }
        primary;
        protocols [inet iso mpls];
        proxy inet-address address;
        receive-options-packets;
        receive-ttl-exceeded;
        remote (inet-address address | mac-address address);
        rpf-check {

```

```

fail-filter filter-name
mode loose;
}
sampling {
input;
output;
}
service {
input {
post-service-filter filter-name;
service-set service-set-name <service-filter filter-name>;
}
output {
service-set service-set-name <service-filter filter-name>;
}
}
service-name-table table-name;
short-cycle-protection <lockout-time-min minimum-seconds lockout-time-max
maximum-seconds>;
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
translate-plp-control-word-de;
unnumbered-address interface-name destination address destination-profile profile-name;
vlan-id number;
vlan-id-list [number number-number];
address address {
arp ip-address (mac | multicast-mac) mac-address <publish>;
broadcast address;
destination address;
destination-profile name;
eui-64;
master-only;
multipoint-destination address dlci dlci-identifier;
multipoint-destination address {
epd-threshold cells;
inverse-arp;
oam-liveness {
up-count cells;
down-count cells;
}
oam-period (disable | seconds);
shaping {
(cbr rate | rtvbr burst length peak rate sustained rate | vbr burst length peak rate
sustained rate);
queue-length number;
}
vci vpi-identifier.vci-identifier;
}
preferred;
primary;
vrrp-group group-id {
(accept-data | no-accept-data);
advertise-interval seconds;
authentication-key key;
authentication-type authentication;
fast-interval milliseconds;

```

```
(preempt | no-preempt) {  
    hold-time seconds;  
}  
priority number;  
track {  
    interface interface-name {  
        bandwidth-threshold bits-per-second priority-cost priority;  
        priority-cost priority;  
    }  
    priority-hold-time seconds;  
    route prefix routing-instance instance-name priority-cost priority;  
}  
}  
virtual-address [ addresses ];  
}  
virtual-link-local-address ipv6-address;  
}
```

|                     |                                                                                                                                                                                                                |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hierarchy Level     | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ] |
| Release Information | Statement introduced before Junos OS Release 7.4.<br>Option <b>max-sessions-vs-a-ignore</b> introduced in Junos OS Release 11.4.                                                                               |
| Description         | Configure protocol family information for the logical interface.                                                                                                                                               |



**NOTE:** Not all subordinate stanzas are available to every protocol family.

---



**Options** *family*—Protocol family:

- **any**—Protocol-independent family used for Layer 2 packet filtering



**NOTE:** This option is not supported on T4000 Type 5 FPCs.

- **bridge**—(M Series and T Series routers only) Configure only when the physical interface is configured with **ethernet-bridge** type encapsulation or when the logical interface is configured with **vlan-bridge** type encapsulation
- **ethernet-switching**—(M Series and T Series routers only) Configure only when the physical interface is configured with **ethernet-bridge** type encapsulation or when the logical interface is configured with **vlan-bridge** type encapsulation
- **ccc**—Circuit cross-connect protocol suite
- **inet**—Internet Protocol version 4 suite
- **inet6**—Internet Protocol version 6 suite
- **iso**—International Organization for Standardization Open Systems Interconnection (ISO OSI) protocol suite
- **mlfr-end-to-end**—Multilink Frame Relay FRF.15
- **mlfr-uni-nni**—Multilink Frame Relay FRF.16
- **multilink-ppp**—Multilink Point-to-Point Protocol
- **mpls**—Multiprotocol Label Switching (MPLS)
- **pppoe**—Point-to-Point Protocol over Ethernet
- **tcc**—Translational cross-connect protocol suite
- **tnp**—Trivial Network Protocol
- **vpls**—(M Series and T Series routers only) Virtual private LAN service

The remaining statements are explained separately.

**Required Privilege Level** *interface*—To view this statement in the configuration.  
*interface-control*—To add this statement to the configuration.

**Related Documentation** *Configuring the Protocol Family*

## fast-aps-switch

---

|                            |                                                                                                                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | fast-aps-switch;                                                                                                                                                                         |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> sonet-options aps]                                                                                                                                |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.1.                                                                                                                                           |
| <b>Description</b>         | (M320 routers with Channelized OC3/STM1 Circuit Emulation PIC with SFP only and EX Series switches) Reduce the Automatic Protection Switching (APS) switchover time in Layer 2 circuits. |

**NOTE:**

- Configuring this statement reduces the APS switchover time only when the Layer 2 circuit encapsulation type for the interface receiving traffic from a Layer 2 circuit neighbor is SAToP.
  - When the fast-aps-switch statement is configured in revertive APS mode, you must configure an appropriate value for revert time to achieve reduction in APS switchover time.
  - To prevent the logical interfaces in the data path from being shut down, configure appropriate hold-time values on all the interfaces in the data path that support TDM.
  - The fast-aps-switch statement cannot be configured when the APS annex-b option is configured.
  - The interfaces that have the fast-aps-switch statement configured cannot be used in virtual private LAN service (VPLS) environments.
- 

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Reducing APS Switchover Time in Layer 2 Circuits</i></li></ul>               |

## fastether-options

```
Syntax fastether-options {
    802.3ad {
        aex (primary | backup);
        lacp {
            port-priority;
        }
    }
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    ingress-rate-limit rate;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
```

**Hierarchy Level** [edit interfaces *interface-name*]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description** Configure Fast Ethernet-specific interface properties.

The statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Interfaces Overview on page 3](#)

## fec

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | fec (efec   gfec   gfec-sdfec   ufec   none);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 9.4.</p> <p>Statement and <b>gfec-sdfec</b> option introduced in Junos OS Release 13.2 for PTX Series routers.</p> <p>Option <b>ufec</b> introduced in Junos OS Release 13.3 for MX Series routers.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | Enable forward error correction (FEC) mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Default</b>                  | If you do not specify a mode, the default mode on PTX Series routers is <b>gfec-sdfec</b> for routers supporting <b>gfec-sdfec</b> mode. . Else, the default value is <b>gfec</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <p>efec—(For M Series, MX Series, and SRX Series routers only) G.975.11.4 enhanced forward error correction (EFEC) is configured to detect and correct bit errors.</p> <p>gfec—(For M Series, MX Series, and SRX Series routers only) G.709 generic forward error correction (GFEC) mode is configured to detect and correct bit errors.</p> <p>gfec-sdfec—(For PTX Series routers only) GFEC and soft-decision forward error correction (SD-FEC) modes are configured to detect and correct bit errors.</p> <p>none—(For M Series, MX Series, and SRX Series routers only) FEC mode is not configured.</p> <p>ufec—(MX Series and PTX Series routers only) Ultra Forward Error Correction (UFEC) mode is configured to detect and correct bit errors.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                             |

---

## fixed-stuff-bytes

---


|                                 |                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (fixed-stuff-bytes   no-fixed-stuff-bytes);                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> <a href="#">rate</a> ]                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | Enable or disable fixed stuff bytes.                                                                                                                                                                                                                                                                           |
| <b>Default</b>                  | By default, no fixed stuff bytes are set.                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <b>fixed-stuff-bytes</b> —Fixed stuff bytes 11.0957 Gbps.<br><b>no-fixed-stuff-bytes</b> —No fixed stuff bytes 11.0491 Gbps.                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## flexible-vlan-tagging

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | flexible-vlan-tagging;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces <i>aex</i> ],<br>[edit interfaces <i>ge-fpc/pic/port</i> ],<br>[edit interfaces <i>et-fpc/pic/port</i> ],<br>[edit interfaces <i>ps0</i> ],<br>[edit interfaces <i>xe-fpc/pic/port</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Support for aggregated Ethernet added in Junos OS Release 9.0.<br>Statement introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.<br>Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Support simultaneous transmission of 802.1Q VLAN single-tag and dual-tag frames on logical interfaces on the same Ethernet port, and on pseudowire logical interfaces.<br><br>This statement is supported on M Series and T Series routers, for Fast Ethernet and Gigabit Ethernet interfaces only on Gigabit Ethernet IQ2 and IQ2-E, IQ, and IQE PICs, and for aggregated Ethernet interfaces with member links in IQ2, IQ2-E, and IQ PICs or in MX Series DPCs, or on Ethernet interfaces for PTX Series Packet Transport Routers or 100-Gigabit Ethernet Type 5 PIC with CFP. This statement is supported on Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces on EX Series switches. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Mixed Tagging on page 239</a></li><li>• <a href="#">Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 241</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## flow-control

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          | (flow-control   no-flow-control);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | [edit interfaces <i>interface-name</i> <a href="#">aggregated-ether-options</a> ],<br>[edit interfaces <i>interface-name</i> ether-options],<br>[edit interfaces <i>interface-name</i> <a href="#">fastether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ],<br>[edit interfaces <i>interface-name</i> multiservice-options],<br>[edit interfaces interface-range <i>name</i> <a href="#">aggregated-ether-options</a> ],<br>[edit interfaces interface-range <i>name</i> ether-options] |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 in EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | For aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only, explicitly enable flow control, which regulates the flow of packets from the router or switch to the remote side of the connection. Enabling flow control is useful when the remote device is a Gigabit Ethernet switch. Flow control is not supported on the 4-port Fast Ethernet PIC.                                                                                                                                                                 |
| <div style="display: flex; align-items: center;">  <div> <p><b>NOTE:</b> On the Type 5 FPC, to prioritize control packets in case of ingress oversubscription, you must ensure that the neighboring peers support MAC flow control. If the peers do not support MAC flow control, then you must disable flow control.</p> </div> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Default</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | Flow control is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Flow Control on page 11</a></li> <li>• <a href="#">Configuring Gigabit Ethernet Interfaces (CLI Procedure)</a></li> <li>• <a href="#">Configuring Gigabit Ethernet Interfaces (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                         |

## fnp

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>fnp {<br/>  interval &lt;100ms   1s   10s   1m   10m&gt;;<br/>  loss-threshold <i>number</i><br/>  interface <i>interface name</i> {<br/>    domain-id <i>domain-id</i><br/>  }<br/>}</pre>                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet</a> ]                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.4.                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | On routers with <b>ge</b> , <b>xe</b> , or <b>ae</b> interfaces, configure an OAM Ethernet failure notification protocol.                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b>interval <i>number</i></b>—Specifies the time between the transmission of FNP messages.</p> <p><b>loss-threshold <i>number</i></b>—FNP messages that can be lost before the FNP message is considered aged out and flushed.</p> <p><b>interface <i>interface-name</i></b>—Name of the Ethernet interface.</p> <p><b>domain-id <i>number</i></b>—Domain ID of the access network.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Failure Notification Protocol Overview on page 633</a></li><li>• <a href="#">Configuring the Failure Notification Protocol on page 692</a></li></ul>                                                                                                                                                                          |

## force switch

---

|                                 |                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>request protection-group ethernet-aps force-switch md &lt;md&gt; ma &lt;ma&gt;</pre>                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit protocols protection-group ethernet-aps]                                                                                                                                                                                                            |
| <b>Description</b>              | Forces traffic to switch from the active path to the alternate path. If the working path is the active path, traffic will be switched to the protection path. If the protection path is the active path, traffic will be switched to the protection path. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Automatic Protection Switching Overview on page 205</a></li></ul>                                                                                                                            |



## force-up

|                                 |                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | force-up;                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces aggregated-ethernet-options lacp]                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX Series routers.                                                                |
| <b>Description</b>              | Configure the peer interface (in MC-LAG) to remain up even with limited LACP capability.                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Forcing MC-LAG Links or Interfaces with Limited LACP Capability to Be Up</i></li> </ul> |

## forwarding-class (Gigabit Ethernet IQ Classifier)

|                                 |                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | forwarding-class <i>class-name</i> {<br>loss-priority (high   low);<br>}                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> together-options ethernet-switch-profile<br>ethernet-policer-profile output-priority-map classifier premium]                                                                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                  |
| <b>Description</b>              | For Gigabit Ethernet IQ interfaces only, define forwarding class name and option values.                                                                                                                                                                                           |
| <b>Options</b>                  | <i>class-name</i> —Name of forwarding class.<br><br>The statements are explained separately.                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Output Priority Map on page 465</a></li> <li>• <a href="#">input-priority-map on page 998</a></li> <li>• forwarding-class statement in the <i>Class of Service Feature Guide for Routing Devices</i></li> </ul> |

## forwarding-mode (100-Gigabit Ethernet)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>forwarding-mode {<br/>    (sa-multicast   ...the following vlan-steering statement...);<br/>    vlan-steering {<br/>        vlan-rule (high-low   odd-even);<br/>    }<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit chassis fpc slot pic slot]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.4.<br>Statement introduced in Junos OS Release 12.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Configure the interoperation mode for 100-Gigabit Ethernet PIC or the 100-Gigabit Ethernet MIC.<br><br>The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 406</a></li><li>• <a href="#">Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-1CE-CFP-FPC4) Using SA Multicast Mode</a></li><li>• <a href="#">Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 410</a></li><li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4 on page 413</a></li><li>• <a href="#">sa-multicast (100-Gigabit Ethernet) on page 1162</a></li><li>• <a href="#">vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1244</a></li><li>• <a href="#">vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1245</a></li></ul> |

## forwarding-mode (PTX Series Packet Transport Routers)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | forwarding-mode {<br><a href="#">sa-multicast</a><br>}                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit chassis fpc <i>slot</i> pic <i>slot</i> port <i>port-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.1X48R4.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | Configure interoperability between 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP.<br><br>The remaining statement is explained separately.                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-1CE-CFP-FPC4 on page 415</a></li> <li>• <a href="#">Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 410</a></li> <li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4 on page 413</a></li> </ul> |

## frame-error

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>frame-error count;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event link-event-rate</a> ],<br>[edit protocols <a href="#">oam link-fault-management interface interface-name event-thresholds</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | <p>Threshold for sending frame error events or taking the action specified in the action profile.</p> <p>A frame error is any frame error on the underlying physical layer. The threshold is reached when the number of frame errors reaches the configured value within the window.</p> <p>The window or period during which frame errors are counted is 5 seconds or multiples of it (with a maximum value of 1 minute). This window denotes the duration as intervals of 100 milliseconds, encoded as a 16-bit unsigned integer. This window is not configurable in Junos OS. According to the IEEE 802.3ah standard, the default value of the frame-errors window is 1 second. This window has a lower bound of 1 second and an upper bound of 1 minute.</p> |
| <b>Options</b>                  | <p><b>count</b>—Threshold count for frame error events.</p> <p><b>Range:</b> 0 through 100</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Threshold Values for Local Fault Events on an Interface on page 600</a></li><li>• <a href="#">Configuring Threshold Values for Fault Events in an Action Profile on page 608</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## frame-period

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>frame-period <i>count</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event link-event-rate</a> ],<br>[edit protocols <a href="#">oam link-fault-management interface <i>interface-name</i> event-thresholds</a> ]                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>Threshold for sending frame period error events or taking the action specified in the action profile.</p> <p>A frame error is any frame error on the underlying physical layer. The frame period threshold is reached when the number of frame errors reaches the configured value within the period window. The default period window is the number of minimum-size frames that can be transmitted on the underlying physical layer in 1 second. The window is not configurable.</p> |
| <b>Options</b>                  | <p><b>count</b>—Threshold count for frame period error events.</p> <p><b>Range:</b> 0 through 100</p>                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Threshold Values for Local Fault Events on an Interface on page 600</a></li> <li>• <a href="#">Configuring Threshold Values for Fault Events in an Action Profile on page 608</a></li> </ul>                                                                                                                                                                                                                            |

## frame-period-summary

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>frame-period-summary count;</code>                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event link-event-rate</a> ],<br>[edit protocols <a href="#">oam link-fault-management interface interface-name event-thresholds</a> ]                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Threshold for sending frame period summary error events or taking the action specified in the action profile.</p> <p>An errored frame second is any 1-second period that has at least one errored frame. This event is generated if the number of errored frame seconds is equal to or greater than the specified threshold for that period window. The default window is 60 seconds. The window is not configurable.</p> |
| <b>Options</b>                  | <p><b>count</b>—Threshold count for frame period summary error events.</p> <p><b>Range:</b> 0 through 100</p>                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Threshold Values for Local Fault Events on an Interface on page 600</a></li><li>• <a href="#">Configuring Threshold Values for Fault Events in an Action Profile on page 608</a></li></ul>                                                                                                                                                                   |

## framing (10-Gigabit Ethernet Interfaces)

|                            |                                                                                                                                                                                                                     |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>framing (lan-phy   wan-phy);</code>                                                                                                                                                                           |
| <b>Hierarchy Level</b>     | <code>[edit interfaces xe-<i>fpc/pic/port</i>]</code><br><code>[edit interfaces et-<i>fpc/pic/port</i>] (PTX Series Packet Transport Routers and MX Series Routers)</code>                                          |
| <b>Release Information</b> | Statement introduced in Junos OS Release 8.0.<br>Statement introduced in Junos OS Release 12.3R2 for PTX Series Packet Transport Routers.                                                                           |
| <b>Description</b>         | For routers supporting the 10-Gigabit Ethernet interface, configure the framing format. WAN PHY mode is supported on MX240, MX480, MX960, T640, T1600, T4000, and PTX Series Packet Transport Routers routers only. |



### NOTE:

- The T4000 Core Router supports only LAN PHY mode in Junos OS Release 12.1R1. Starting with Junos OS Release 12.1R2, WAN PHY mode is supported on the T4000 routers with the 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP). Starting with Junos OS Release 12.2, WAN PHY mode is supported on the T4000 routers with the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP).
- On PTX Series routers, WAN PHY mode is supported only on the 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ .
- When the PHY mode changes, interface traffic is disrupted because of port reinitialization.

|                                 |                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Default</b>                  | Operates in LAN PHY mode.                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <b>lan-phy</b> —10GBASE-R interface framing format that bypasses the WIS sublayer to directly stream block-encoded Ethernet frames on a 10-Gigabit Ethernet serial interface.<br><br><b>wan-phy</b> —10GBASE-W interface framing format that allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and SONET devices. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet Framing Overview on page 385</a></li> <li>• <i>Configuring SONET Options for 10-Gigabit Ethernet Interfaces</i></li> </ul>                                                                                                                                  |

## gigether-options

```

Syntax  gigether-options {
        802.3ad {
            aex (primary | backup);
            lacp {
                port-priority;
            }
        }
        (asynchronous-notification | no-asynchronous-notification);
        (auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
            local-interface-offline>;
        (flow-control | no-flow-control);
        ignore-l3-incompletes;
        (loopback | no-loopback);
        mpls {
            pop-all-labels {
                required-depth number;
            }
        }
        no-auto-mdix
        source-address-filter {
            mac-address;
        }
        (source-filtering | no-source-filtering);
        speed
        ethernet-switch-profile {
            (mac-learn-enable | no-mac-learn-enable);
            tag-protocol-id [ tpids ];
            ethernet-policer-profile {
                input-priority-map {
                    ieee802.1p premium [ values ];
                }
                output-priority-map {
                    classifier {
                        premium {
                            forwarding-class class-name {
                                loss-priority (high | low);
                            }
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit bps;
                    burst-size-limit bytes;
                }
                premium {
                    bandwidth-limit bps;
                    burst-size-limit bytes;
                }
            }
        }
    }

```



```
}
```

|                                 |                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                 |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                        |
| <b>Description</b>              | Configure Gigabit Ethernet specific interface properties.<br><br>The statements are explained separately.                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Interfaces Overview on page 3</a></li> <li>• <i>gether-options (ACX Series)</i></li> </ul> |

## gratuitous-arp-reply

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (gratuitous-arp-reply   no-gratuitous-arp-reply);                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]<br>[edit interfaces <i>interface-range</i> <i>interface-range-name</i> ]       |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                       |
| <b>Description</b>              | For Ethernet interfaces, enable updating of the Address Resolution Protocol (ARP) cache for gratuitous ARPs.            |
| <b>Default</b>                  | Updating of the ARP cache is disabled on all Ethernet interfaces.                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Interfaces Feature Guide for Security Devices</i></li> </ul>                |

## guest-vlan (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>guest-vlan (vlan-id   vlan-name);</code>                                                                                                                  |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [interface-names]) dot1x]</code>                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                         |
| <b>Description</b>              | Specify the VLAN to which an interface is moved when no 802.1X supplicants are connected on the interface. The VLAN specified must already exist on the switch. |
| <b>Default</b>                  | None                                                                                                                                                            |
| <b>Options</b>                  | <b><i>vlan-id</i></b> —VLAN tag identifier of the guest VLAN.<br><b><i>vlan-name</i></b> —Name of the guest VLAN.                                               |
| <b>Required Privilege Level</b> | <b>routing</b> —To view this statement in the configuration.<br><b>routing-control</b> —To add this statement to the configuration.                             |

## guard-interval


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>guard-interval <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring <i>ring-name</i></a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | When a link goes down, the ring protection link (RPL) activates. When the downed link comes back up, the RPL link receives notification, restores the link, and waits for the restore interval before issuing another block on the same link. This configuration is a global configuration and applies to all Ethernet rings if the Ethernet ring does not have a more specific configuration for this value. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value. |
| <b>Options</b>                  | <b><i>number</i></b> —Guard timer interval, in milliseconds.<br><b>Range:</b> 10 through 2000 ms<br><b>Default:</b> 500 ms                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li> <li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li> </ul>                                                                                                    |

## hardware-assisted-timestamping

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | hardware-assisted-timestamping;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | <p>For Ethernet interfaces on Enhanced and Enhanced Queuing Dense Port Concentrators (DPCs) in MX Series routers only, enable hardware-assisted timestamping support for Ethernet frame delay measurement.</p> <p>By default, the ETH-DM feature calculates frame delays using software-based timestamping of the ETH-DM PDU frames sent and received by the MEPs in the session. As an option that can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction, you can enable hardware-assisted timestamping of session frames in the receive direction.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Frame Delay Measurements Overview on page 622</a></li><li>• <a href="#">Guidelines for Configuring Routers to Support an ETH-DM Session on page 664</a></li><li>• <a href="#">Enabling the Hardware-Assisted Timestamping Option on page 674</a></li></ul>                                                                                                                                                                                                                                                                                                |

## hardware-assisted-keepalives

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | hardware-assisted-keepalives [enable   disable];                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">performance-monitoring</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2R1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>For Ethernet interfaces on Modular Port Concentrators (MPCs) in MX Series routers only, delegate the transmission of the continuity check messages (CCMs) to the forwarding ASIC (that is, to the hardware) by enabling inline transmission. Inline transmission of CCMs is also known as Inline-KA.</p> <p>By default, CCMs are transmitted by the CPU of the MPC and not the hardware. If the duration between transmissions of CCMs is low or if the CCMs for a specific line card scale, we recommend that you enable delegation of the transmission of CCMs to the hardware. By enabling inline transmission of CCMs, you can achieve maximum scaling of CCMs.</p> |
|                                 | <div>  <p><b>NOTE:</b> Starting from Junos OS Release 15.1F5, the supported CCM interval values for MPC7E are 100ms, 10ms, and 1s.</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Default</b>                  | Inline transmission is disabled by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p><b>enable</b>—Enable inline transmission of CCMs.</p> <p><b>disable</b>—Disable inline transmission of CCMs.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling on page 688</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## hold-interval (OAM)

---

|                                 |                                                                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | hold-interval <i>minutes</i> ;                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> <a href="#">continuity-check</a> ]                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in junos os release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                           |
| <b>Description</b>              | The time to wait before flushing the maintenance association end point (MEP) database, if no updates occur. The configurable range is 1 minute through 30240 minutes.                                                                                |
| <b>Options</b>                  | <i>minutes</i> —Time to wait, in minutes.                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Continuity Check Protocol Parameters for Fault Detection on page 529</a></li><li>• <a href="#">Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</a></li></ul> |

## hold-interval (Protection Group)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | hold-interval <i>number</i> ;                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring name</a> ]                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify the hold-off timer interval <i>for all rings</i> in 100 millisecond (ms) increments.                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <i>number</i> —Hold-timer interval, in milliseconds.<br><b>Range:</b> 0 through 10,000 ms<br><b>Default:</b> 100 ms                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</a></li><li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</a></li></ul> |

---

## hold-multiplier

---

|                                 |                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>hold-multiplier <i>number</i>;</code>                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ]                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                                                  |
| <b>Description</b>              | Configure a value for the LLDP hold multiplier.<br><br>Hold timer interval in seconds to cache learned LLDP information before discarding.                                                     |
| <b>Options</b>                  | <b><i>number</i></b> —Advertisement interval multiplier for LLDP cache discard.<br><b>Default:</b> 4 (giving 120 second LLDP cache lifetime with other defaults)<br><b>Range:</b> 2 through 10 |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                                                                                 |

## iccp

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> iccp {     traceoptions; {         file &lt;filename&gt; &lt;files number&gt; &lt;match regular-expression&gt; &lt;microsecond-stamp&gt;         &lt;size size&gt; &lt;world-readable   no-world-readable&gt;;         flag flag;         no-remote-trace;     }     local-ip-address ip address;     session-establishment-hold-time value;     authentication-key string;     peer ip-address {         local-ip-address ip address;         session-establishment-hold-time value;         authentication-key string;         redundancy-group-id-list redundancy-group-id-list;         liveness-detection;     } } </pre>                                                                                                                        |
| <b>Hierarchy Level</b>          | <pre> [edit protocols iccp] [edit logical-systems logical-system-name protocols iccp] </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 10.0.</p> <p>Support for logical systems introduced in Junos OS Release 14.1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | <p>Configure Interchassis Control Protocol (ICCP) between the multichassis link aggregation group (MC-LAG) peers. ICCP replicates forwarding information, validates configurations, and propagates the operational state of the MC-LAG members.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Default</b>                  | <p>If you do not include this statement, no ICCP protocol tracing operations are performed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <p><b>traceoptions</b>—Set Interchassis Control Protocol (ICCP) tracing options.</p> <p><b>local-ip-address</b>—Specify the source address where the ICCP packet is routed.</p> <p><b>session-establishment-hold-time</b>—Specify if the chassis takes over as the master at the ICCP session.</p> <p><b>authentication-key</b>—Specify TCP Message Digest 5 (MD5) option for an ICCP TCP session.</p> <p><b>peer ip-address</b>—Specify the IP address of the peer that hosts an MC-LAG. You must configure ICCP for both peers that host the MC-LAG.</p> <p><b>redundancy-group-id-list</b>—Specify the redundancy groups between two ICCP peers.</p> <p><b>liveness-detection</b>—Specify Bidirectional Forwarding Detection (BFD) protocol options.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



**Related Documentation** • [Configuring ICCP for MC-LAG](#)

## id (MACsec for MX Series)

|                                 |                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | id {<br>mac-address <i>mac-address</i> ;<br>port-id <i>port-id-number</i> ;<br>}                                                                                                       |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> ]                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                     |
| <b>Description</b>              | Specify a MAC address and a port that traffic on the link must be from to be accepted by the interface when MACsec is enabled using static secure association key (SAK) security mode. |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                     |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                        |
| <b>Related Documentation</b>    | • <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a>                                                                                   |

## ieee802.1p

|                                 |                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ieee802.1p premium [ <i>values</i> ];                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile ethernet-policer-profile input-priority-map</a> ]<br>[edit interfaces <i>interface-name</i> ether-options <a href="#">ethernet-switch-profile ethernet-policer-profile input-priority-map</a> ] |
| <b>Release Information</b>      | Statement introduced before Junos Release 7.4.<br>Statement introduced in Junos OS Release 13.2 for the QFX Series.                                                                                                                                                                         |
| <b>Description</b>              | For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, configure premium priority values for IEEE 802.1p input traffic.                                                                                                                                                           |
| <b>Options</b>                  | <b>values</b> —Define IEEE 802.1p priority values to be treated as premium.<br><b>Range:</b> 0 through 7                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                     |
| <b>Related Documentation</b>    | • <a href="#">Specifying an Input Priority Map on page 465</a>                                                                                                                                                                                                                              |

## igmp-snooping

```
Syntax  igmp-snooping {
        immediate-leave;
        interface interface-name {
            group-limit limit;
            host-only-interface;
            immediate-leave;
            multicast-router-interface;
            static {
                group ip-address {
                    source ip-address;
                }
            }
        }
        proxy {
            source-address ip-address;
        }
        query-interval seconds;
        query-last-member-interval seconds;
        query-response-interval seconds;
        robust-count number;
        vlan vlan-id {
            immediate-leave;
            interface interface-name {
                group-limit limit;
                host-only-interface;
                immediate-leave;
                multicast-router-interface;
                static {
                    group ip-address {
                        source ip-address;
                    }
                }
            }
            proxy {
                source-address ip-address;
            }
            query-interval seconds;
            query-last-member-interval seconds;
            query-response-interval seconds;
            robust-count number;
        }
    }
```

**Hierarchy Level** [edit bridge-domains *bridge-domain-name* protocols],  
 [edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols]  
 [edit routing-instances *routing-instance-name* protocols]  
 [edit protocols]

**Release Information** Statement introduced in Junos OS Release 8.5.

**Description** Enable IGMP snooping on the router.



**NOTE:** IGMP snooping must be disabled on the router before enabling ISSU.

|                                 |                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Default</b>                  | IGMP snooping is disabled on the router.                                                                                                            |
| <b>Options</b>                  | The statements are explained separately.                                                                                                            |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Understanding IGMP Snooping</i></li> <li>• <i>IGMP Snooping in MC-LAG Active-Active Mode</i></li> </ul> |

## ignore-l3-incompletes

|                                 |                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ignore-l3-incompletes;                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">fastether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.0.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                  |
| <b>Description</b>              | Ignore the counting of Layer 3 incomplete errors on Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces.                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ignoring Layer 3 Incomplete Errors on page 18</a></li> </ul>                                        |

## include-sci (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | include-sci;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Specifies that the SCI tag should be appended to each packet on a link that has enabled MACsec.</p> <p>SCI tags are automatically appended to packets leaving a MACsec-enabled interface on an MX240, MX480, or MX960 router. This option is, therefore, redundant to be configured.</p> <p>This option is used only when connecting a router to a host device that requires SCI tagging. SCI tags are eight octets long, so appending an SCI tag to all traffic on the link adds a significant amount of unneeded overhead.</p> |
| <b>Default</b>                  | SCI tagging is enabled on MX Series routers that have enabled MACsec using static connectivity association key (CAK) security mode, by default.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                |

## ingress-policer-overhead

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>ingress-policer-overhead bytes;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>     | <code>[edit chassis fpc slot-number pic pic-number]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b> | Statement introduced before Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 15.1X49-D30 for vSRX.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>         | <p>Add the configured number of bytes to the length of a packet entering the interface.</p> <p>Configure a policer overhead to control the rate of traffic received on an interface. Use this feature to help prevent denial-of-service (DoS) attacks or to enforce traffic rates to conform to the service-level agreement (SLA). When you configure a policer overhead, the configured policer overhead value (bytes) is added to the length of the final Ethernet frame. This calculated length of frame is used to determine the policer or the rate-limiting action.</p> <p>Traffic policing combines the configured policy bandwidth limits and the burst size to determine how to meter the incoming traffic. If you configure a policer overhead on an interface, Junos OS adds those bytes to the length of incoming Ethernet frames. This added overhead fills each frame closer to the burst size, allowing you to control the rate of traffic received on an interface.</p> <p>You can configure the policer overhead to rate-limit queues and Layer 2 and Layer 3 policers, for standalone (SA) and high-availability (HA) deployments. The policer overhead and the shaping overhead can be configured simultaneously on an interface.</p> |



**NOTE:** vSRX supports policer overhead on Layer 3 policers only.

The policer overhead applies to all interfaces on the PIC. In the following example, Junos OS adds 10 bytes of overhead to all incoming Ethernet frames on ports ge-0/0/0 through ge-0/0/4.

```
set chassis fpc 0 pic 0 ingress-policer-overhead 10
```



**NOTE:** vSRX only supports fpc 0 pic 0. When you commit the `ingress-policer-overhead` statement, the vSRX takes the PIC offline and then back online.

You need to craft the policer overhead size to match your network traffic. A value that is too low will have minimal impact on traffic bursts. A value that is too high will rate-limit too much of your incoming traffic.

In this example, the policer overhead of 255 bytes is configured for ge-0/0/0 through ge-0/0/4. The firewall policer is configured to discard traffic when the burst size is over

1500 bytes. This policer is applied to ge-0/0/0 and ge 0/0/1. Junos OS adds 255 bytes to every Ethernet frame that comes into the configured ports. If, during a burst of traffic, the combined length of incoming frames and the overhead bytes exceeds 1500 bytes, the policer starts to discard further incoming traffic.

```
set chassis fpc 0 pic 0 ingress-policer-overhead 255
set interfaces ge-0/0/0 unit 0 family inet policer input overhead_policer
set interfaces ge-0/0/0 unit 0 family inet address 10.9.1.2/24
set interfaces ge-0/0/1 unit 0 family inet policer input overhead_policer
set interfaces ge-0/0/1 unit 0 family inet address 10.9.2.2/24
set firewall policer overhead_policer if-exceeding bandwidth-limit 32k
set firewall policer overhead_policer if-exceeding burst-size-limit 1500
set firewall policer overhead_policer then discard
```

**Options** *bytes*—Number of bytes added to a frame entering an interface.

**Range:** 0–255 bytes

**Default:** 0

```
[edit chassis fpc 0 pic 0]
user@host# set ingress-policer-overhead 10;
```

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [set firewall policer](#)

---

## ingress-rate-limit

---

**Syntax** *ingress-rate-limit rate;*

**Hierarchy Level** [edit interfaces *interface-name* fastether-options]

**Release Information** Statement introduced before Junos OS Release 7.4.

**Description** Perform port-based rate limiting on ingress traffic arriving on Fast Ethernet 8-port, 12-port, and 48-port PICs.

**Options** *rate*—Traffic rate, in megabits per second (Mbps).

**Range:** 1 through 100 Mbps

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring the Ingress Rate Limit on page 9](#)

## inner-tag-protocol-id

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>inner-tag-protocol-id <i>tpid</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</p>                      |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 8.1.</p> <p>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | <p>Configure the IEEE 802.1Q TPID value to rewrite for the inner tag.</p> <p>All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces <i>interface-name</i> <i>gether-options</i> <a href="#">ethernet-switch-profile</a> <a href="#">tag-protocol-id</a> [ <i>tpids</i> ]] hierarchy level.</p> <p>On MX Series routers, you can use this statement for Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs.</p> |
| <b>Default</b>                  | If the <code>inner-tag-protocol-id</code> statement is not configured, the TPID value is 0x8100.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Configuring Inner and Outer TPIDs and VLAN IDs on page 490</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## inner-vlan-id

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>inner-vlan-id number;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | <code>[edit interfaces interface-name unit logical-unit-number input-vlan-map],</code><br><code>[edit interfaces interface-name unit logical-unit-number output-vlan-map],</code><br><code>[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number input-vlan-map],</code><br><code>[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number output-vlan-map]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers or 100-Gigabit Ethernet Type 5 PIC with CFP, or on Ethernet interfaces on EX Series switches, specify the VLAN ID to rewrite for the inner tag of the final packet.</p> <p>You cannot include the <code>inner-vlan-id</code> statement with the <code>swap</code> statement, <code>swap-push</code> statement, <code>push-push</code> statement, or <code>push-swap</code> statement and the <code>inner-vlan-id</code> statement at the <code>[edit interfaces interface-name unit logical-unit-number output-vlan-map]</code> hierarchy level. If you include any of those statements in the output VLAN map, the VLAN ID in the outgoing frame is rewritten to the <code>inner-vlan-id</code> statement you include at the <code>[edit interfaces interface-name unit logical-unit-number]</code> hierarchy level.</p> |
| <b>Options</b>                  | <code>number</code> —VLAN ID number.<br><b>Range:</b> 0 through 4094                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b> | <code>interface</code> —To view this statement in the configuration.<br><code>interface-control</code> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Inner and Outer TPIDs and VLAN IDs on page 490</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



## input-policer

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>input-policer <i>policer-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Apply a single-rate two-color policer to the Layer 2 input traffic at the logical interface. The <b>input-policer</b> and <b>input-three-color</b> statements are mutually exclusive.                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <b><i>policer-name</i></b> —Name of the single-rate two-color policer that you define at the <b>[edit firewall]</b> hierarchy level.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Two-Color and Three-Color Policers at Layer 2</i></li> <li>• <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i></li> <li>• <a href="#">Configuring a Gigabit Ethernet Policer on page 465</a></li> <li>• <a href="#">input-three-color on page 999</a></li> <li>• <a href="#">layer2-policer on page 1020</a></li> <li>• <a href="#">logical-interface-policer on page 1040</a></li> <li>• <a href="#">output-policer on page 1101</a></li> <li>• <a href="#">output-three-color on page 1103</a></li> </ul> |

## input-priority-map

---

|                                 |                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>input-priority-map {<br/>    <a href="#">ieee802.1p</a> premium [ <i>values</i> ];<br/>}</pre>                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | <pre>[edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a><br/>    <a href="#">ethernet-policer-profile</a>]<br/>[edit interfaces <i>interface-name</i> ether-options <a href="#">ethernet-switch-profile</a><br/>    <a href="#">ethernet-policer-profile</a>]</pre> |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 13.2 for the QFX Series.                                                                                                                                                                                          |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the input policer priority map to be applied to incoming frames on this interface.</p> <p>The statements are explained separately.</p>                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying an Input Priority Map on page 465</a></li><li>• <a href="#">output-priority-map on page 1102</a></li></ul>                                                                                                                                       |

## input-three-color

---


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>input-three-color <i>policer-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Apply a single-rate or two-rate three-color policer to the Layer 2 input traffic at the logical interface. The <b>input-three-color</b> and <b>input-policer</b> statements are mutually exclusive.                                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <b><i>policer-name</i></b> —Name of the single-rate or two-rate three-color policer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Usage Guidelines</b>         | See <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Two-Color and Three-Color Policers at Layer 2</i></li> <li>• <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i></li> <li>• <a href="#">Configuring a Gigabit Ethernet Policer on page 465</a></li> <li>• <a href="#">input-policer on page 997</a></li> <li>• <a href="#">layer2-policer on page 1020</a></li> <li>• <a href="#">logical-interface-policer on page 1040</a></li> <li>• <a href="#">output-policer on page 1101</a></li> <li>• <a href="#">output-three-color on page 1103</a></li> </ul> |

## input-vlan-map (Aggregated Ethernet)

---

|                                 |                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>input-vlan-map {<br/>    (pop   push   swap);<br/>    tag-protocol-id <i>tpid</i>;<br/>    vlan-id <i>number</i>;<br/>}</pre>                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ]                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                                                                               |
| <b>Description</b>              | <p>For aggregated Ethernet interfaces using Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and 100-Gigabit Ethernet Type 5 PIC with CFP only, define the rewrite profile to be applied to incoming frames on this logical interface.</p> <p>The statements are explained separately.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Stacking a VLAN Tag on page 493</a></li><li>• <a href="#">output-vlan-map (Aggregated Ethernet) on page 1104</a></li></ul>                                                                                                                              |

## input-vlan-map

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <pre>input-vlan-map {   (pop   pop-pop   pop-swap   push   push-push   swap   swap-push   swap-swap);   inner-tag-protocol-id <i>tpid</i>;   inner-vlan-id <i>number</i>;   tag-protocol-id <i>tpid</i>;   vlan-id <i>number</i>; }</pre>                                                                                                                                    |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <pre>[edit interfaces <i>interface-name</i> <i>unit</i> <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <i>unit</i> <i>logical-unit-number</i>]</pre>                                                                                                                                                         |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>Statement introduced before Junos OS Release 7.4.</p> <p><b>pop-pop</b>, <b>pop-swap</b>, <b>push-push</b>, <b>swap-push</b>, and <b>swap-swap</b> statements introduced in Junos OS Release 8.1.</p> <p>Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.</p> |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>For Gigabit Ethernet IQ, 10-Gigabit Ethernet SFPP interfaces, 100-Gigabit Ethernet Type 5 PIC with CFP only as well as Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces, define the rewrite profile to be applied to incoming frames on this logical interface.</p> <p>The statements are explained separately.</p>         |
| <div style="display: flex; align-items: flex-start;"> <div style="flex: 1; text-align: center; margin-right: 10px;">  </div> <div> <p><b>NOTE:</b> Connectivity fault management (CFM) sessions for all interfaces in which <b>input-vlan-map</b> is configured are supported only if the interface also has an explicit configuration for <b>output-vlan-map</b> as <b>output-vlan-map pop</b>. See <a href="#">output-vlan-map</a>. This configuration is required for all the interfaces in the topology even when the CFM session is on that interface or on a different interface in the data path of the same topology.</p> </div> </div> |                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• <a href="#">Stacking a VLAN Tag on page 493</a></li> <li>• <a href="#">output-vlan-map on page 1105</a></li> <li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li> </ul>                                                                                                                                          |

## instance

---

|                                 |                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>instance <i>vpls-instance-name</i>;</code>                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>name</i> ]                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                              |
| <b>Description</b>              | Specify the VPLS instance of the default maintenance domain.                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Maintenance Intermediate Points (MIPs) on page 526</a></li><li>• <a href="#">maintenance-domain on page 1053</a></li></ul> |

## interface

|                            |                                                                                                                |
|----------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | interface (all   <i>interface-name</i> ) {<br><b>disable</b> ;<br>}                                            |
| <b>Hierarchy Level</b>     | [edit protocols <b>lldp</b> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <b>lldp</b> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.6.                                                                  |
| <b>Description</b>         | Specify an LLDP interface.                                                                                     |
| <b>Options</b>             | <i>interface-name</i> —A valid physical interface name.                                                        |



**NOTE:** On MX Series and T Series routers, you run LLDP on a physical interface, such as ge-1/0/0, and not at the logical interface (unit) level.

Starting with Junos OS Release 14.2, you can also specify LLDP neighbor details for management interfaces, such as fxp or me, on MX Series routers.

For information about interface names, see *Interface Naming Overview*. For information about interface names for TX Matrix routers, see *TX Matrix Router Chassis and Interface Names*. For information about FPC numbering on TX Matrix routers, see *Routing Matrix with a TX Matrix Router FPC Numbering*.

For information about extended port names in the Junos Fusion technology, see *Understanding Junos Fusion Ports*.

**all**—Run LLDP on all interfaces.

**disable**—Disable LLDP on the specified interface

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring LLDP on page 316</a></li> </ul>                    |

## interface (IEEE 802.1x)

---

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>interface <i>interface-id</i> {<br/>    maximum-requests <i>integer</i>;<br/>    quiet-period <i>seconds</i>;<br/>    reauthentication (disable   interval <i>seconds</i>);<br/>    retries <i>integer</i>;<br/>    server-timeout <i>seconds</i>;<br/>    supplicant (<i>single</i>);<br/>    supplicant-timeout <i>seconds</i>;<br/>    transmit-period <i>seconds</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>     | [edit protocols <a href="#">dot1x authenticator</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>         | Use this statement to configure the 802.1x Port-Based Network Access Control protocol-specific Ethernet interface options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Default</b>             | The default values are provided for the options below on the respective statement pages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>             | <p><b>maximum-requests</b>—Specify the maximum number of retransmission times for an EAPOL Request packet to the client before it times out the authentication session.</p> <p><b>quiet-period</b>—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting the authentication.</p> <p><b>reauthentication</b>—Includes two options:</p> <ul style="list-style-type: none"><li>• <b>disable</b>—Periodic reauthentication of the client is disabled.</li><li>• <b>interval</b>—Specify the periodic reauthentication time interval.</li></ul> <p><b>retries</b>—Specify the number of tries after which the port remains in the wait state for <b>quiet-period</b> seconds before reattempting the authentication.</p> <p><b>server-timeout</b>—Specify the number of seconds the port waits for a reply when relaying a response from the client to the authentication server before timing out and invoking the server-fail action.</p> <p><b>supplicant (<i>single</i>)</b>—Specify supplicant single mode. See the usage guidelines to configure other modes.</p> <p><b>supplicant-timeout</b>—Specify the number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.</p> <p><b>transmit-period</b>—Specify the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.</p> |



**Required Privilege** interface—To view this statement in the configuration.  
**Level** interface-control—To add this statement to the configuration.

**Related Documentation**

- [IEEE 802.1x Port-Based Network Access Control Overview on page 33](#)
- [authenticator on page 881](#)
- [dot1x on page 931](#)

## interface (OAM Link-Fault Management)

**Syntax**

```
interface interface-name {
  apply-action-profile profile-name;
  link-discovery (active | passive);
  pdu-interval interval;
  pdu-threshold threshold-value;
  remote-loopback;
  event-thresholds {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
  }
  negotiation-options {
    allow-remote-loopback;
    no-allow-link-events;
  }
}
```

**Hierarchy Level** [edit protocols [oam ethernet link-fault-management](#)]

**Release Information** Statement introduced in Junos OS Release 8.2.

**Description** For Ethernet interfaces on M320, MX Series, and T Series routers, configure IEEE 802.3ah Operation, Administration, and Management (OAM) support.

**Options** **interface** *interface-name*—Interface to be enabled for IEEE 802.3ah link fault management OAM support.

The remaining statements are described separately.

**Required Privilege** interface—To view this statement in the configuration.  
**Level** interface-control—To add this statement to the configuration.

**Related Documentation**

- [Enabling IEEE 802.3ah OAM Support on page 597](#)

## interface (Static MAC Bypass)

---

|                                 |                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>interface [<i>interface-names</i>];</code>                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                         |
| <b>Description</b>              | Configure interfaces on which the specified MAC addresses are allowed to bypass RADIUS authentication and allowed to connect to the LAN without authentication. |
| <b>Options</b>                  | <i>interface-names</i> —List of interfaces.                                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                             |
| <b>Related Documentation</b>    |                                                                                                                                                                 |

## interface-down

---

|                                 |                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>interface-down;</code>                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet <a href="#">connectivity-fault-management action-profile</a> <i>profile-name</i> <a href="#">default-actions</a> ]      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                        |
| <b>Description</b>              | Bring the interface down when a remote MEP connectivity failure is detected.                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538</a></li></ul> |

---

## interfaces

---

|                                 |                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | interfaces { ... }                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit]                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                   |
| <b>Description</b>              | Configure interfaces on the router.                                                                                                                                                                 |
| <b>Default</b>                  | The management and internal Ethernet interfaces are automatically configured. You must configure all other interfaces.                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Physical Interface Configuration Statements Overview</i></li><li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li></ul> |

## interfaces (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>interfaces <i>interface-name</i> {<br/>    connectivity-association <i>connectivity-association-name</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit security macsec]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Applies the specified connectivity association to the specified interface to enable MACsec.</p> <p>One connectivity association can be applied to multiple interfaces.</p> <p>You must always use this statement to apply a connectivity association to an interface to enable MACsec. You must complete this configuration step regardless of whether MACsec is enabled using static connectivity association key (CAK) security mode or static secure association key (SAK) security mode.</p> <p>If you are enabling MACsec using static SAK security mode and need to configure MACsec on inbound and outbound traffic on the same interface, you must configure a connectivity association with one secure channel for inbound traffic and a second secure channel for outbound traffic. The connectivity association is then applied to the interface using this statement to enable MACsec for traffic entering and leaving the interface.</p> |
| <b>Default</b>                  | Interfaces are not associated with any connectivity associations, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## interface-none

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | interface-none;                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name east-interface</a> ]<br>[edit protocols <a href="#">protection-group ethernet-ring ring-name west-interface</a> ]                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Designates port as not used for Ethernet ring protection.                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul> |

## interface-status-tlv

---

|                                 |                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | interface-status-tlv [ down lower-layer-down ];                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet</a> connectivity-fault-management <a href="#">action-profile profile-name</a> event]                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Defines an <b>action-profile</b> consisting of various events and the action. Based on values of <b>interface-status-tlv</b> in the received CCM packets, specific action such as <i>interface-down</i> can be taken using <b>action-profile</b> options.                                                                         |
| <b>Options</b>                  | <p><b>down</b>—When the incoming CCM packet contains interface status TLV with value down, the action will be triggered for this action-profile.</p> <p><b>lower-layer-down</b>—When the incoming CCM packet contains interface status TLV with value lower-layer-down, the action will be triggered for this action-profile.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Remote MEP Action Profile Support on page 548</a></li> </ul>                                                                                                                                                                                                     |

## interval

|                            |                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>interval value;</code>                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>otn-options signal-degrade</b> ]<br>[edit interfaces <i>interface-name</i> <b>otn-options odu-signal-degrade</b> ]                                                                                                                                                                                                                          |
| <b>Release Information</b> | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>         | Specify the interval for which the BER must stay above the signal degradation threshold—as configured in the <b>ber-threshold-signal-degrade value</b> statement—for the alarm to be raised. After an alarm is raised, if the BER returns below the clear threshold—as configured in the <b>ber-threshold-clear value</b> statement—for the specified interval, the alarm is cleared. |



**NOTE:** Configuring a high BER threshold for signal degradation and a long interval might cause the internal bit error counter register to get saturated. For example, for the P1-PTX-2-100G-WDM PIC, the internal bit error counter gets saturated when the error count reaches  $2E+29$ . Therefore, the value of **ber-threshold-signal-degrade \* line rate / interval** must be less than  $2E+29$  to avoid saturation. Assuming a fixed PIC line rate of  $1.27E+11$  bits per second and an interval of 1000 ms, the **ber-threshold-signal-degrade** value must be less than  $4.22E-3$ .

If the value of the **ber-threshold-signal-degrade \* line rate / interval** exceeds the saturation limit, the configuration is ignored by the router, and the default values are used instead. A system log message is logged for this error.

If you configure the BER thresholds at the [edit interfaces *interface-name* **otn-options signal-degrade**] hierarchy level, then the thresholds are calculated using the pre-forward error correction (pre-FEC) BER (the BER before FEC correction). These thresholds are used for pre-FEC BER monitoring. See “[Understanding Pre-FEC BER Monitoring and BER Thresholds](#)” on page 431 for more information about pre-FEC BER monitoring and determining BER threshold settings.

If you configure the BER thresholds at the [edit interfaces *interface-name* **otn-options odu-signal-degrade**] hierarchy level, then the thresholds are calculated using the post-FEC BER (the BER after FEC correction). This BER is referred to as the optical channel data unit (ODU) BER.



**NOTE:** You can configure ODU BER thresholds only at the [edit interfaces *interface-name* **otn-options odu-signal-degrade**] hierarchy level on the P2-100GE-OTN PIC.

**Options** *value*—Time interval in milliseconds.



**NOTE:** For the P1-PTX-2-100G-WDM PIC, the BER must stay above the signal degradation threshold for ten consecutive intervals for the alarm to be raised and the BER must stay below the clear threshold for ten consecutive intervals for the alarm to be cleared. For example, if the interval is configured as 10 ms, then the BER must stay above the signal degradation threshold for 100 ms (10 ms \* 10 intervals) for the alarm to be raised, or below the clear threshold for 100 ms for the alarm to be cleared.



**NOTE:** For P1-PTX-24-10G-W-SFPP PIC and P2-100GE-OTN PIC, when the router cannot configure BER with the given interval, it selects an optimum interval that is supported for the given BER configuration. If the router is still not able to support the configuration (for example, with a wider gap between the degrade set and clear values), the default values are used and a log is generated.

**Range:** 1 ms through 1000 ms.

**Default:** 10 ms

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## interval (CFM MEP)

**Syntax** interval (1m | 1s);

**Hierarchy Level** [edit protocols oam ethernet connectivity-fault-management action-profile  
*action-profile-name* action log-and-generate-ais]

**Release Information** Statement introduced in Junos OS Release 14.2.

**Description** Configure the interval between AIS messages that are to be received by the MEP as either 1 minute or 1 second.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Alarm Indication Signal \(ETH-AIS\) Function Overview on page 693](#)
- [Configuring ETH-AIS on a CFM MEP on page 696](#)


## is-ma

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (is-ma   no-is-ma);                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify whether masked alarms are enabled or disabled.                                                                                                                                                            |
| <b>Default</b>                  | If you omit the is-ma statement, masked alarms are disabled.                                                                                                                                                      |
| <b>Options</b>                  | <b>is-ma</b> —Enable masked alarms.<br><b>no-is-ma</b> —Do not enable masked alarms.                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |



## isolated-vlan (MX Series)

|                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                          | <code>isolated-vlan <i>vlan-id</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                 | <p>[edit <code>bridge-domains</code> <i>bridge-domain-name</i> ],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> <code>bridge-domains</code> <i>bridge-domain-name</i> bridge-options],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> <code>bridge-domains</code> <i>bridge-domain-name</i> ,</p> <p>[edit routing-instances <i>routing-instance-name</i> <code>bridge-domains</code> <i>bridge-domain-name</i> ],</p> |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                             | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                     | Configure the specified isolated VLAN to be a secondary VLAN of the specified primary VLAN. An isolated VLAN receives packets only from the primary VLAN and forwards frames upstream to the primary VLAN.                                                                                                                                                                                                                                                                                                                              |
| <div>  <p><b>NOTE:</b> When you specify this configuration statement, the VLAN ID of a logical interface that you associate with a bridge domain that matches with the VLAN ID that you specify using the <code>isolated-vlan</code> state is treated as an isolated port.</p> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Options</b>                                                                                                                                                                                                                                                                                                                                                         | <i>vlan-id</i> —Individual VLAN IDs separated by a space.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                        | <p>system—To view this statement in the configuration.</p> <p>system—control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## iteration-count

---

|                          |                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | iteration-count <i>count-value</i> ;                                                                                                                                                                                                                                                                                                                             |
| Hierarchy Level          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">maintenance-domain</a> <i>md-name</i> <a href="#">maintenance-association</a> <i>ma-name</i> <a href="#">mep</a> <i>mep-id</i> <a href="#">remote-mep</a> <i>remote-mep-id</i> <a href="#">sla-iterator-profile</a> <i>profile-name</i> ] |
| Release Information      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                   |
| Description              | Configure the number of iterations for which the connection partakes in the iterator for acquiring SLA measurements.                                                                                                                                                                                                                                             |
| Options                  | <b>count-value</b> —Number of iterations for which the connection should partake in the iterator for acquiring SLA measurements.<br><b>Range:</b> 1 through 65,535<br><b>Default:</b> 0 (or infinite iterations)                                                                                                                                                 |
| Required Privilege Level | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                                                                                   |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">sla-iterator-profile on page 1184</a></li><li>• <a href="#">Configuring a Remote MEP with an Iterator Profile on page 662</a></li></ul>                                                                                                                                                                      |

## iteration-period

---

|                          |                                                                                                                                                                                                               |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | iteration-period <i>iteration-period-value</i> ;                                                                                                                                                              |
| Hierarchy Level          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">performance-monitoring</a> <a href="#">sla-iterator-profiles</a> <i>profile-name</i> ] |
| Release Information      | Statement introduced in Junos OS Release 11.1.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                                       |
| Description              | Configure the iteration period, which is the maximum number of cycles per iteration (that is, the number of connections registered to an iterator cannot exceed this value).                                  |
| Options                  | <b>iteration-period-value</b> —Maximum number of cycles per iteration.<br><b>Range:</b> 1 through 2000<br><b>Default:</b> 2000                                                                                |
| Required Privilege Level | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring an Iterator Profile on a Switch (CLI Procedure)</a></li></ul>           |

## key (MACsec for MX Series)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>key key-string;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> security-association <i>security-association-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>Specifies the static security key to exchange to enable MACsec using static secure association key (SAK) security mode.</p> <p>The key string is a 32-digit hexadecimal number. The key string and the security association must match on both sides of an Ethernet connection to secure traffic using MACsec when enabling MACsec using SAK security mode.</p> <p>You must configure at least two security associations with unique security association numbers and key strings to enable MACsec using static SAK security mode. MACsec initially establishes a secure connection when a security association number and key match on both ends of an Ethernet link. After a certain number of Ethernet frames are securely transmitted across the Ethernet link, MACsec automatically rotates to a new security association with a new security association number and key to maintain the secured Ethernet link. This rotation continues each time a certain number of Ethernet frames are securely transmitted across the secured Ethernet link, so you must always configure MACsec to have at least two security associations.</p> |
| <b>Default</b>                  | This statement does not have a default value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <b><i>key-string</i></b> —Specifies the key to exchange with the other end of the link on the secure channel. The <i>key-string</i> is a 32-digit hexadecimal string that is created by the user.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## key-server-priority (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>key-server-priority <i>priority-number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> mka]                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Specifies the key server priority used by the MACsec Key Agreement (MKA) protocol to select the key server when MACsec is enabled using static connectivity association key (CAK) security mode.</p> <p>The switch with the lower <i>priority-number</i> is selected as the key server.</p> <p>If the <i>priority-number</i> is identical on both sides of a point-to-point link, the MKA protocol selects the device with the lower MAC address as the key server.</p> |
| <b>Default</b>                  | The default key server priority number is 16.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><i>priority-number</i>—Specifies the MKA server election priority number.</p> <p>The <i>priority-number</i> can be any number between 0 and 255. The lower the number, the higher the priority.</p>                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                       |


---

## lacp (802.3ad)

---

|                                 |                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>lacp {<br/>    port-priority <i>port-priority</i><br/>}</code>                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> fastether-options <a href="#">802.3ad</a> ],<br>[edit interfaces <i>interface-name</i> gigether-options <a href="#">802.3ad</a> ]                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                 |
| <b>Description</b>              | Configure the Link Aggregation Control Protocol (LACP) port priority for Ethernet interfaces.                                                                                                                                 |
| <b>Options</b>                  | <i>port-priority</i> —Priority for being elected as the active port to collect and distribute traffic.<br>A smaller value indicates a higher priority for selection.<br><b>Range:</b> 0 through 65,535<br><b>Default:</b> 127 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LACP for Aggregated Ethernet Interfaces on page 148</a></li><li>• <a href="#">port-priority on page 1123</a></li></ul>                                        |

## lACP (Aggregated Ethernet)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>lACP {   (active   passive);   admin-key key;   accept-data;   fast-failover;   link-protection {     disable;     (revertive   non-revertive);   }   periodic interval;   system-id mac-address;   system-priority priority; }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>     | <p>[edit interfaces aeX <b>aggregated-ether-options</b>]</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces aeX aggregated-ether-options]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b> | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p><b>fast-failover</b> option introduced in Junos OS Release 12.2.</p> <p>Support for logical systems introduced in Junos OS Release 14.1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>         | <p>Configure the Link Aggregation Control Protocol (LACP) for aggregated Ethernet interfaces only.</p> <p>When you configure the <b>accept-data</b> statement at the [edit interfaces aeX <b>aggregated-ether-options lACP</b>] hierarchy level, the router processes packets received on a member link irrespective of the LACP state if the aggregated Ethernet bundle is up.</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <p> <b>NOTE:</b> When you configure the <b>accept-data</b> statement at the [edit interfaces aeX aggregated-ether-options lACP] hierarchy level, this behavior occurs:</p> <ul style="list-style-type: none"> <li>• By default, the <b>accept-data</b> statement is not configured when LACP is enabled.</li> <li>• You can configure the <b>accept-data</b> statement to improve convergence and reduce the number of dropped packets when member links in the bundle are enabled or disabled.</li> <li>• When LACP is down and a member link receives packets, the router or switch does not process packets as defined in the IEEE 802.1ax standard. According to this standard, the packets should be dropped, but they are processed instead because the <b>accept-data</b> statement is configured.</li> </ul> </div> |
| <b>Default</b>             | If you do not specify LACP as either <b>active</b> or <b>passive</b> , LACP remains passive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>             | <b>active</b> —Initiate transmission of LACP packets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**admin-key *number***—Specify an administrative key for the router or switch.



**NOTE:** You must also configure multichassis link aggregation (MC-LAG) when you configure the **admin-key**.

**fast-failover**—Specify to override the IEEE 802.3ad standard and allow the standby link to receive traffic. Overriding the default behavior facilitates subsecond failover.

**passive**—Respond to LACP packets.

The remaining statements are explained separately.

|                                 |                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.                                                                              |
|                                 | interface-control—To add this statement to the configuration.                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring LACP for Aggregated Ethernet Interfaces on page 148</a></li> </ul> |

## laser-enable

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (laser-enable   no-laser-enable);                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                               |
| <b>Description</b>              | Specify whether lasers are enabled or disabled.                                                                                                                                                                      |
| <b>Default</b>                  | If you omit the laser-enable statement, lasers are disabled.                                                                                                                                                         |
| <b>Options</b>                  | <b>laser-enable</b> —Enable lasers.                                                                                                                                                                                  |
|                                 | <b>no-laser-enable</b> —Do not enable lasers.                                                                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.                                                                                                                                                               |
|                                 | interface-control—To add this statement to the configuration.                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## layer2-policer

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>layer2-policer {<br/>    input-policer <i>policer-name</i>;<br/>    input-three-color <i>policer-name</i>;<br/>    output-policer <i>policer-name</i>;<br/>    output-three-color <i>policer-name</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Release Information      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description              | <p>For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M Series, MX Series, and T Series routers, and for aggregated Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces on EX Series switches, apply Layer 2 logical interface policers. The following policers are supported:</p> <ul style="list-style-type: none"><li>• Two-color</li><li>• Single-rate tricolor marking (srTCM)</li><li>• Two-rate tricolor marking (trTCM)</li></ul> <p>Two-color and tricolor policers are configured at the <b>[edit firewall]</b> hierarchy level.</p>                                                                                                                                                                                               |
| Options                  | <p><b>input-policer <i>policer-name</i></b>—Two-color input policer to associate with the interface. This statement is mutually exclusive with the <b>input-three-color</b> statement.</p> <p><b>input-three-color <i>policer-name</i></b>—Tricolor input policer to associate with the interface. This statement is mutually exclusive with the <b>input-policer</b> statement.</p> <p><b>output-policer <i>policer-name</i></b>—Two-color output policer to associate with the interface. This statement is mutually exclusive with the <b>output-three-color</b> statement.</p> <p><b>output-three-color <i>policer-name</i></b>—Tricolor output policer to associate with the interface. This statement is mutually exclusive with the <b>output-policer</b> statement.</p> |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Related Documentation    | <ul style="list-style-type: none"><li>• <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i></li><li>• <a href="#">Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



## level

|                                 |                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>level <i>number</i>;</code>                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management <a href="#">maintenance-domain</a> <i>domain-name</i> ]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in junos os release 12.1X48 for PTX Series Packet Transport Routers.                                                                                  |
| <b>Description</b>              | A number used in CFM messages to identify the maintenance association.                                                                                                                                                      |
| <b>Options</b>                  | <i>number</i> —A number used to identify the maintenance domain to which the CFM message belongs.<br><b>Range:</b> 0 through 7                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Maintenance Domain Level on page 525</a></li> <li>• <a href="#">Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</a></li> </ul> |

## level (CFM MEP)

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>level <i>value</i>;</code>                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> action log-and-generate-ais]                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                       |
| <b>Description</b>              | Configure the server maintenance domain level for the MEP.                                                                                                                                                           |
| <b>Options</b>                  | <i>value</i> —Maintenance domain level.<br><b>Range:</b> 1 through 7                                                                                                                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li> <li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li> </ul> |

## line-loopback

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (line-loopback-enable   no-line-loopback);                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                            |
| <b>Description</b>              | Specify whether line-loopback is enabled or disabled.                                                                                                                                                             |
| <b>Default</b>                  | If you omit the line-loopback-enable statement, line-loopback is disabled.                                                                                                                                        |
| <b>Options</b>                  | <b>line-loopback-enable</b> —Enable line-loopback.<br><br><b>no-line-loopback</b> —Disable line-loopback.                                                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## linktrace

---

|                                 |                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | linktrace {<br><a href="#">age</a> (30m   10m   1m   30s   10s);<br><a href="#">path-database-size</a> <i>path-database-size</i> ;<br>} |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management</a> ]                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                           |
| <b>Description</b>              | Configure connectivity fault management linktrace parameters.                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Linktrace Protocol in CFM on page 539</a></li></ul>                     |

## link-adjacency-loss

---

|                                 |                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | link-adjacency-loss;                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event</a> ]                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                     |
| <b>Description</b>              | Loss of adjacency with IEEE 802.3ah link-fault management peer event. When included, the loss-of-adjacency event triggers the action specified under the <b>action</b> statement. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Monitoring the Loss of Link Adjacency on page 606</a></li> </ul>                                                             |

## link-discovery

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | link-discovery (active   passive);                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management interface interface-name</a> ]                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | For Ethernet interfaces on EX Series switches, and M320, M120, MX Series, and T Series routers, specify the discovery mode used for IEEE 802.3ah Operation, Administration, and Management (OAM) support. The discovery process is triggered automatically when OAM 802.3ah functionality is enabled on a port. Link monitoring is done when the interface sends periodic OAM PDUs. |
| <b>Options</b>                  | (active   passive)—Passive or active mode. In active mode, the interface discovers and monitors the peer on the link if the peer also supports IEEE 802.3ah OAM functionality. In passive mode, the peer initiates the discovery process. Once the discovery process is initiated, both sides participate in discovery.                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Link Discovery on page 598</a></li> </ul>                                                                                                                                                                                                                                                                          |

## link-down

---

|                                 |                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | link-down;                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management</a> ]                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                     |
| <b>Description</b>              | Mark the interface down for transit traffic.                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Actions to Be Taken for Link-Fault Management Events on page 605</a></li></ul> |

## link-event-rate

---

|                                 |                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | link-event-rate {<br><a href="#">frame-error</a> <i>count</i> ;<br><a href="#">frame-period</a> <i>count</i> ;<br><a href="#">frame-period-summary</a> <i>count</i> ;<br><a href="#">symbol-period</a> <i>count</i> ;<br>} |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event</a> ]                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                                                              |
| <b>Description</b>              | Configure the number of link-fault management events per second.                                                                                                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Threshold Values for Fault Events in an Action Profile on page 608</a></li></ul>                                                                           |

## link-fault-management

```
Syntax  link-fault-management {
        action-profile profile-name {
            action {
                link-down;
                send-critical-event;
                syslog;
            }
            event {
                link-adjacency-loss;
                link-event-rate {
                    frame-error count;
                    frame-period count;
                    frame-period-summary count;
                    symbol-period count;
                }
                protocol-down;
            }
        }
    }
    interface interface-name {
        apply-action-profile profile-name;
        link-discovery (active | passive);
        loopback-tracking;
        pdu-interval interval;
        pdu-threshold threshold-value;
        remote-loopback;
        event-thresholds {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
        negotiation-options {
            allow-remote-loopback;
            no-allow-link-events;
        }
    }
}
```

**Hierarchy Level** [edit protocols [oam](#) [ethernet](#)]

**Release Information** Statement introduced in Junos OS Release 8.2.

**Description** For Ethernet interfaces on M320, M120, MX Series, and T Series routers and EX Series switches, specify fault signaling and detection for IEEE 802.3ah Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

- Related Documentation**
- [Enabling IEEE 802.3ah OAM Support on page 597](#)

## link-mode

|                            |                                                                                                                                                                                                                     |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>link-mode mode;</code>                                                                                                                                                                                        |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> ],<br>[edit interfaces <i>interface-name</i> ether-options],<br>[edit interfaces <i>ge-pim</i> /0/0 <i>switch-options</i> <i>switch-port</i> <i>port-number</i> ]            |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers. |
| <b>Description</b>         | Set the device's link connection characteristic.                                                                                                                                                                    |

**Options** *mode*—Link characteristics:

- **automatic**—Link mode is negotiated. This is the default for EX Series switches.
- **full-duplex**—Connection is full duplex.
- **half-duplex**—Connection is half duplex.

**Default:** Fast Ethernet interfaces, can operate in either full-duplex or half-duplex mode. The router's management Ethernet interface, **fxp0** or **em0**, and the built-in Fast Ethernet interfaces on the FIC (M7i router) autonegotiate whether to operate in full-duplex or half-duplex mode. Unless otherwise noted here, all other interfaces operate only in full-duplex mode.



### NOTE:

- On EX4300 switches, the interfaces operate in full-duplex mode only.
- On EX Series switches, if **no-auto-negotiation** is specified in [edit interfaces *interface-name* ether-options], you can select only full-duplex or half-duplex. If **auto-negotiation** is specified, you can select any mode.



**NOTE:** Member links of an aggregated Ethernet bundle must not be explicitly configured with a link mode. You must remove any such link-mode configuration before committing the aggregated Ethernet configuration.

|                                 |                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the Link Characteristics on Ethernet Interfaces on page 12</a></li> <li>• <i>Understanding Management Ethernet Interfaces</i></li> <li>• <i>Configuring Gigabit Ethernet Interfaces (CLI Procedure)</i></li> </ul> |

- *Configuring Gigabit Ethernet Interfaces (CLI Procedure)*

---

## link-protection

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>link-protection {<br/>    disable;<br/>    (revertive   non-revertive);<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Hierarchy Level          | <pre>[edit interfaces aex aggregated-ether-options]<br/>[edit interfaces aex aggregated-ether-options lcp]</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Release Information      | <p>Statement introduced in Junos OS Release 8.3.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for <b>disable</b>, <b>revertive</b>, and <b>non-revertive</b> statements added in Junos OS Release 9.3.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description              | <p>On the router, for aggregated Ethernet interfaces only, configure link protection. In addition to enabling link protection, a primary and a secondary (backup) link must be configured to specify what links egress traffic should traverse. To configure primary and secondary links on the router, include the <b>primary</b> and <b>backup</b> statements at the <b>[edit interfaces ge-fpc/pic/port gigether-options 802.3ad aex]</b> hierarchy level or the <b>[edit interfaces fe-fpc/pic/port fastether-options 802.3ad aex]</b> hierarchy level.</p> <p>On the switch, you can configure either Junos OS link protection for aggregated Ethernet interfaces or the LACP standards link protection for aggregated Ethernet interfaces.</p> <p>For Junos OS link protection, specify <b>link-protection</b> at the following hierarchy levels:</p> <ul style="list-style-type: none"><li>• <b>[edit interfaces ge-fpc/pic/port ether-options 802.3ad aex]</b></li><li>• <b>[edit interfaces xe-fpc/pic/port ether-options 802.3ad aex]</b> hierarchy level or at the <b>[edit interfaces xe-fpc/pic/port ether-options 802.3ad aex]</b> hierarchy level.</li></ul> <p>To disable link protection, use the <b>delete interface ae aggregate-ether-options link-protection</b> statement at the <b>[edit interfaces aex aggregated-ether-options]</b> hierarchy level or the <b>[edit interfaces aex aggregated-ether-options lcp]</b> hierarchy level.</p> |
| Options                  | The statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Required Privilege Level | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li><li>• <i>Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



## link-speed (Aggregated Ethernet)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>link-speed <i>speed</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>     | [edit interfaces aex <a href="#">aggregated-ether-options</a> ],<br>[edit interfaces interface-range <i>name</i> aggregated-ether-options],<br>[edit interfaces interface-range <i>name</i> aggregated-sonet-options]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br><b>mixed</b> option added in Junos OS Release 15.1F3 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>         | For aggregated Ethernet interfaces only, set the required link speed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>             | <p><b><i>speed</i></b>—For aggregated Ethernet links, you can specify <b><i>speed</i></b> in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation <b>k</b> (1000), <b>m</b> (1,000,000), or <b>g</b> (1,000,000,000).</p> <p>Aggregated Ethernet links on the M120 router can have one of the following speeds:</p> <ul style="list-style-type: none"> <li>• <b>100m</b>—Links are 100 Mbps.</li> <li>• <b>10g</b>—Links are 10 Gbps.</li> <li>• <b>1g</b>—Links are 1 Gbps.</li> <li>• <b>oc192</b>—Links are OC192 or STM64c.</li> </ul> <p>Aggregated Ethernet links on EX Series switches can be configured to operate at one of the following speeds:</p> <ul style="list-style-type: none"> <li>• <b>10m</b>—Links are 10 Mbps.</li> <li>• <b>100m</b>—Links are 100 Mbps.</li> <li>• <b>1g</b>—Links are 1 Gbps.</li> <li>• <b>10g</b>—Links are 10 Gbps.</li> </ul> <p>Aggregated Ethernet links on T Series routers can be configured to operate at one of the following speeds:</p> <ul style="list-style-type: none"> <li>• <b>100g</b>—Links are 100 Gbps.</li> <li>• <b>100m</b>—Links are 100 Mbps.</li> <li>• <b>10g</b>—Links are 10 Gbps.</li> <li>• <b>1g</b>—Links are 1 Gbps.</li> <li>• <b>40g</b>—Links are 40 Gbps.</li> <li>• <b>50g</b>—Links are 50 Gbps.</li> <li>• <b>80g</b>—Links are 80 Gbps.</li> <li>• <b>8g</b>—Links are 8 Gbps.</li> </ul> |

- **mixed**—Links are of various speeds.
- **oc192**—Links are OC192.

**mixed**—Enables bundling of different Ethernet rate links in the same Aggregated Ethernet interface on PTX Series routers.

|                           |                                                               |
|---------------------------|---------------------------------------------------------------|
| <b>Required Privilege</b> | interface—To view this statement in the configuration.        |
| <b>Level</b>              | interface-control—To add this statement to the configuration. |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <a href="#">Aggregated Ethernet Interfaces Overview on page 122</a></li><li>• <a href="#">Configuring Aggregated Ethernet Link Speed on page 144</a></li><li>• <a href="#">Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136</a></li><li>• <a href="#">Configuring Aggregated Ethernet Links (CLI Procedure)</a></li><li>• <a href="#">Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch</a></li></ul> |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## link-speed (Aggregated SONET/SDH)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | link-speed ( <i>speed</i>   mixed);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces asx aggregated-sonet-options]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br><b>mixed</b> option added in Release 8.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | For aggregated SONET/SDH interfaces only, set the required link speed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | <p><b>speed</b>—Aggregated SONET/SDH links can have one of the following speed values.</p> <ul style="list-style-type: none"> <li>• <b>oc3</b>—Links are OC3c or STM1c.</li> <li>• <b>oc12</b>—Links are OC12c or STM4c.</li> <li>• <b>oc48</b>—Links are OC48c or STM16c.</li> <li>• <b>oc192</b>—Links are OC192c or STM64c.</li> <li>• <b>oc768</b>—Links are OC768c or STM256c.</li> </ul> <p><b>mixed</b>—For aggregated SONET/SDH links on T Series routers, you can mix interface speeds in SONET/SDH aggregation bundles. Interface speeds from OC3 through OC768 are supported.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Aggregated Ethernet Link Speed on page 144</a></li> <li>• <a href="#">Configuring Aggregated SONET/SDH Interfaces</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                            |

## lldp

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>lldp {<br/>    advertisement-interval <i>seconds</i>;<br/>    disable;<br/>    hold-multiplier <i>number</i>;<br/>    interface (all   <i>interface-name</i>) {<br/>        disable;<br/>    }<br/>    lldp-configuration-notification-interval <i>seconds</i>;<br/>    management-address <i>ip-management-address</i>;;<br/>    port-description-type {<br/>        interface-alias;<br/>        interface-description;<br/>    }<br/>    port-id-subtype {<br/>        interface-name;<br/>        locally-assigned;<br/>    }<br/>    ptopo-configuration-maximum-hold-time <i>seconds</i>;<br/>    ptopo-configuration-trap-interval <i>seconds</i>;<br/>    traceoptions {<br/>        file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>maximum-file-size</i>&gt; &lt;world-readable  <br/>        no-world-readable&gt;;<br/>        flag <i>flag</i> &lt;disable&gt;;<br/>    }<br/>    transmit-delay <i>seconds</i>;<br/>}</pre> |
| Hierarchy Level          | [edit protocols],<br>[edit routing-instances <i>routing-instance-name</i> protocols]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Release Information      | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description              | (MX Series and T Series routers only) Specify LLDP configuration parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Options                  | The statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Required Privilege Level | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

---

## lldp-configuration-notification-interval

---

|                                 |                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | lldp-configuration-notification-interval <i>seconds</i> ;                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ]                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                       |
| <b>Description</b>              | Configure a time for the period of SNMP trap notifications to the Master Agent to wait regarding changes in database information.                                   |
| <b>Options</b>                  | <b><i>seconds</i></b> —Time for the period of SNMP trap notifications about the LLDP database. This feature is disabled by default.<br><b>Range:</b> 0 through 3600 |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                                                      |

## lmi (Ethernet OAM)

**Syntax**

```
lmi {
    status-counter count;
    polling-verification-timer value;
    interface name {
        uni-id uni-name;
        status-counter number;
        polling-verification-timer value;
        evc-map-type (all-to-one-bundling | bundling | service-multiplexing);
        evc evc-name {
            default-evc;
            vlan-list vlan-id-list;
        }
    }
}
```

**Hierarchy Level** [edit protocols [oam](#) [ethernet](#)]

**Release Information** Statement introduced in Junos OS Release 9.5.

**Description** On routers with **ge**, **xe**, or **ae** interfaces, configure an OAM Ethernet Local Management Interface (E-LMI).



**NOTE:** On MX Series routers, E-LMI is supported on Gigabit Ethernet (**ge**), 10-Gigabit Ethernet (**xe**), and Aggregated Ethernet (**ae**) interfaces configured on MX Series routers with DPC only.

**Options**

- status-counter *count***—Status counter (N393), defaults to 4.
- interface *name***—Polling verification timer (T392), defaults to 15 seconds.
- uni-id *uni-name***—(Optional) Defaults to the physical interface name.
- status-counter *number***—(Optional) Defaults to a global value.
- polling-verification-timer *value***—(Optional) Defaults to a global value.
- evc-map-type (all-to-one-bundling | bundling | service-multiplexing)**—Specify the Ethernet virtual connection (EVC) map type.
- evc *evc-name***—Specify the name of the EVC.
- default-evc**—Set the specified EVC as the default EVC.
- vlan-list *vlan-id-list***—Specify a group of VLANs to assign to the EVC.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

- Related Documentation**
- [Configuring Ethernet Local Management Interface on page 540](#)
  - [evcs on page 957](#)

## load-balance

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>load-balance {   adaptive{     pps;     scan-interval <i>multiple</i>;     tolerance <i>percentage</i>;   }   no-adaptive;   per-packet; }</pre>                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces aex aggregated-ether-options]                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 13.3.</p> <p>Statement introduced in Junos OS Release 14.1 for PTX Series Packet Transport Routers.</p>                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | Load-balances the received traffic across all the available paths of aggregated Ethernet bundles for better link utilization.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <p><b>adaptive</b>— (MX Series and PTX Series) Corrects a genuine traffic imbalance by using a feedback mechanism to distribute the traffic across the links of an Aggregated Ethernet bundle.</p> <p><b>no-adaptive</b>— (MX Series and PTX Series) Disables the adaptive load-balancing solution configured to distribute traffic by using a feedback mechanism.</p> <p><b>per-packet</b>— (MX Series only) Randomly sprays packets to the aggregate next hops in a round-robin manner to avoid traffic imbalance.</p> |
| <b>Required Privilege Level</b> | <p>interface - To view statement in the configuration.</p> <p>interface-control - To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Understanding Aggregated Ethernet Load Balancing on page 166</a></li> <li>• <a href="#">Example: Configuring Aggregated Ethernet Load Balancing on page 171</a></li> </ul>                                                                                                                                                                                                                                                                                          |

## load-balance-stateful (Aggregated Ethernet Interfaces)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>load-balance-stateful {<br/>    per-flow;<br/>    rebalance <i>interval</i>;<br/>    load-type (low   medium   large);<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces aeX <i>unit logical-unit-number</i> forwarding-options]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | Define the capability to perform uniform load balancing and also perform rebalancing is introduced on MX Series routers with MPCs, except MPC3Es and MPC4Es. Rebalancing is not supported when load-balancing is skewed or distorted owing to a change in the number of flows. The mechanism to record and retain states for the flows and distribute the traffic load accordingly is added. As a result, for m number of flows, they are distributed among n member links of a LAG bundle or among the unilist of next-hops in an ECMP link. This method of splitting the load among member links is called stateful load balancing and it uses 5-tuple information (source and destination addresses, protocol, source and destination ports). Such a method can be mapped directly to the flows, or to a precompute hash based on certain fields in the flow. As a result, the deviation observed on each child link is reduced. |
| <b>Options</b>                  | <b>stateful</b> —Define the stateful load-distribution mechanism for traffic flows on aggregated Ethernet interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



## load-type (Aggregated Ethernet Interfaces)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | load-type (low   medium   large);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Define the load-balancing type to inform the Packet Forwarding Engine regarding the appropriate memory pattern to be used for traffic flows. The approximate number of flows for effective load-balancing for each keyword is a derivative.                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <p><b>low</b>—Define a low load-balancing method if the number of flows that flow on the specified aggregated Ethernet interface is less or minimal (between 1 and 100 flows).</p> <p><b>medium</b>—Define a medium or moderate load-balancing method if the number of flows that flow on the specified aggregated Ethernet interface is relatively higher (between 100 and 1000 flows).</p> <p><b>large</b>—Define a high load-balancing method if the number of flows that flow on the specified aggregated Ethernet interface is excessive or reaches the maximum supported flows (between 1000 and 10,000 flows).</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## local-loopback

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (local-loopback-enable   no-local-loopback);                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify whether local-loopback is enabled or disabled.                                                                                                                                                            |
| <b>Default</b>                  | If you omit the local-loopback-enable statement, local-loopback is disabled.                                                                                                                                      |
| <b>Options</b>                  | <b>local-loopback-enable</b> —Enable local-loopback.<br><b>no-local-loopback</b> —Disable local-loopback.                                                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## lockout

---

|                                 |                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | request protection-group ethernet-aps lockout md <md> ma <ma>                                                                                 |
| <b>Hierarchy Level</b>          | [edit protocols protection-group ethernet-aps]                                                                                                |
| <b>Description</b>              | Configure a lockout of the protection path, forcing the use of the working path and locking out the protect path regardless of anything else. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Automatic Protection Switching Overview on page 205</a></li></ul>                |


---

## log-and-generate-ais

---

|                                 |                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>log-and-generate-ais {<br/>    interval (1m   1s);<br/>    level level;<br/>    priority level;<br/>}</pre>                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile<br>action-profile-name action]                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                                                     |
| <b>Description</b>              | Configure the action be taken when an AIS alarm is detected. The action includes generating and logging the AIS statistics along with the interval between AIS messages, the server maintenance domain level, and the priority of the AIS message. |
| <b>Options</b>                  | The other statements are explained separately.                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul>                                  |

## logical-interface-policer

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | logical-interface-policer;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>[edit dynamic-profiles <i>profile-name</i> firewall policer <i>policer-name</i>],</p> <p>[edit dynamic-profiles <i>profile-name</i> firewall three-color-policer <i>name</i>],</p> <p>[edit firewall atm-policer <i>atm-policer-name</i>],</p> <p>[edit firewall policer <i>policer-name</i>],</p> <p>[edit firewall policer <i>policer-template-name</i>],</p> <p>[edit firewall three-color-policer <i>policer-name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> firewall policer <i>policer-name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> firewall three-color-policer <i>name</i>]</p> |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Support at the [edit firewall three-color-policer <i>policer-name</i>] hierarchy level introduced in Junos OS Release 8.2.</p> <p>Logical systems support introduced in Junos OS Release 9.3.</p> <p>Support at the [edit dynamic-profiles ... policer <i>policer-name</i>] and [edit dynamic-profiles ... three-color-policer <i>name</i>] hierarchy levels introduced in Junos OS Release 11.4.</p> <p>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.</p>                                                                                    |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | Configure a logical interface policer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <div style="display: flex; align-items: center;">  <div> <p><b>NOTE:</b> Starting in Junos OS Release 12.2R2, on T Series Core Routers only, you can configure an MPLS LSP policer for a specific LSP to be shared across different protocol family types. You must include the logical-interface-policer statement to do so.</p> </div> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• <a href="#">Two-Color and Three-Color Logical Interface Policers</a></li> <li>• <a href="#">Traffic Policer Types</a></li> <li>• <a href="#">Configuring and Applying Tricolor Marking Policers</a></li> <li>• <a href="#">action</a></li> <li>• <a href="#">Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 471</a></li> <li>• <a href="#">action</a></li> </ul>                                                                                                                                                                                                     |

## loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet)

|                            |                                                                                                                                                                                                                                                                                                                                               |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | (loopback   no-loopback);                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>aggregated-ether-options</b> ],<br>[edit interfaces <i>interface-name</i> ether-options],<br>[edit interfaces <i>interface-name</i> <b>fastether-options</b> ],<br>[edit interfaces <i>interface-name</i> <b>gigether-options</b> ],<br>[edit interfaces interface-range <i>name</i> ether-options] |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                           |
| <b>Description</b>         | For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces, enable or disable loopback mode.                                                                                                                                                                                                                |



### NOTE:

- By default, local aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces connect to a remote system.
- IPv6 Neighbor Discovery Protocol (NDP) addresses are not supported on Gigabit Ethernet interfaces when loopback mode is enabled on the interface. That is, if the loopback statement is configured at the [edit interfaces *ge-fpc/pic/port* gigether-options] hierarchy level, an NDP address cannot be configured at the [edit interfaces *ge-fpc/pic/port* unit *logical-unit-number* family inet6 address] hierarchy level.

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Ethernet Loopback Capability on page 17</a></li> </ul> |

## loopback (Local and Remote)

---

|                                 |                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>loopback (local   remote);</code>                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1F3 for PTX Series routers.                                                                                                            |
| <b>Description</b>              | Enables local loopback and enables remote loopback. This allows you to test the transceiver cable connection from the far end to the retimer interface without changing the cable. |
| <b>Options</b>                  | <b>local</b> —Enables local loopback<br><b>remote</b> —Enables remote loopback                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Ethernet Loopback Capability</a></li></ul>                                                                         |

## loopback-tracking

---

|                                 |                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>loopback-tracking;</code>                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet <a href="#">link-fault-management</a> ]                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | Enables loopback tracking on Ethernet interfaces. When loopback tracking is enabled and the Ethernet Operation, Administration, and Management (OAM) link-fault management process (lfmd) detects its own generated packets on an interface, it marks the interface as down. When the loopback issue resolves, the interface is brought back up. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">IEEE 802.3ah OAM Link-Fault Management Overview on page 594</a></li><li>• <a href="#">Enabling IEEE 802.3ah OAM Support on page 597</a></li></ul>                                                                                                                                            |

## loss-priority

|                                 |                                                                                                                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>loss-priority (high   low);</code>                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">output-priority-map</a> <a href="#">classifier</a> <a href="#">premium</a> <a href="#">forwarding-class</a> <i>class-name</i> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                    |
| <b>Description</b>              | Specify the packet loss priority value.                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><b>high</b>—Packet has high loss priority.</p> <p><b>low</b>—Packet has low loss priority.</p>                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Output Priority Map on page 465</a></li> </ul>                                                                                                                                                                    |

## loss-threshold

|                                 |                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>loss-threshold <i>number</i>;</code>                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> <a href="#">continuity-check</a> ]                                                                              |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 8.4.</p> <p>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.</p>                                                                                                   |
| <b>Description</b>              | Specify the number of continuity check messages lost before marking the remote MEP as down.                                                                                                                                                             |
| <b>Options</b>                  | <b><i>number</i></b> —The number of continuity check messages that can be lost before the remote MEP is considered down.                                                                                                                                |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Continuity Check Protocol Parameters for Fault Detection on page 529</a></li> <li>• <a href="#">Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</a></li> </ul> |

## lowest-priority-defect

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | lowest-priority-defect (all-defects   err-xcon   mac-rem-err-xcon   no-defect   rem-err-xcon   xcon)                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> mep <i>mep-id</i> ]                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Specify the lowest priority defect that is allowed to generate a Fault Alarm whenever CFM detects a defect. This configuration is done at the MEP level.                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p>Specify one of the following lowest priority defect options:</p> <p><b>all-defects</b>—Allows all defects.</p> <p><b>err-xcon</b>—Allows only erroneous CCM and cross-connect CCM defects.</p> <p><b>mac-rem-err-xcon</b>—Allows only MAC, not receiving CCM, erroneous CCM, and cross-connect defects.</p> <p><b>no-defect</b>—Allows no defects.</p> <p><b>rem-err-xcon</b>—Allows only not receiving CCM, erroneous CCM, and cross-connect CCM defects.</p> <p><b>xcon</b>—Allows only cross-connect CCM defects.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the Maintenance End Point Lowest Priority Defect on page 530</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                  |



## mac

|                                 |                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac mac-address;</code>                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                       |
| <b>Description</b>              | Set the MAC address of the interface. You can configure the MAC address on the management Ethernet interface ( <b>fxp0</b> or <b>em0</b> ) only.                                                                                        |
| <b>Options</b>                  | <b>mac-address</b> —MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: <i>nnnn.nnnn.nnnn</i> or <i>nn:nn:nn:nn:nn:nn</i> . For example, <b>0011.2233.4455</b> or <b>00:11:22:33:44:55</b> . |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the MAC Address on the Management Ethernet Interface on page 27</a></li> <li>• <a href="#">Configuring a Pseudowire Subscriber Logical Interface Device</a></li> </ul> |

## mac (IRB)

|                                 |                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac mac-address;</code>                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>irb</i> unit <i>logical-unit-number</i> ]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2.                                                                                                                         |
| <b>Description</b>              | Specify the MAC address of the IRB interface in devices that have Modular Port Concentrator (MPC) cards.                                                               |
| <b>Options</b>                  | <b>mac-address</b> — Specify the MAC address as six hexadecimal bytes in one of the following hexadecimal formats: <i>nnnn:nnnn:nnnn</i> or <i>nn:nn:nn:nn:nn:nn</i> . |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Example: Configuring the MAC Address of an IRB Interface on page 306</a></li> </ul>                               |

## mac-address (Accept Source Mac)

---

|                                 |                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac-address <i>mac-address</i> <a href="#">policer</a>;</code>                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">accept-source-mac</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">accept-source-mac</a> ]                                        |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                                                                                                 |
| <b>Description</b>              | For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), for Gigabit Ethernet DPCs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP, specify a remote MAC address on which to count incoming and outgoing packets. |
| <b>Options</b>                  | <b><i>mac-address</i></b> —MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: <i>nnnn.nnnn.nnnn</i> or <i>nn:nn:nn:nn:nn:nn</i> . For example, 0011.2233.4455 or 00:11:22:33:44:55.<br><br><b><i>policer</i></b> —MAC policer. For more information, see <a href="#">policer (MAC)</a> .        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring MAC Address Filtering on page 465</a></li></ul>                                                                                                                                                                                                                             |

## mac-address (MACsec)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac-address <i>mac-address</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> id]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Specify a MAC address to enable MACsec using static secure association key (SAK) security mode. The <b>mac-address</b> variables must match on the sending and receiving ends of a link to enable MACsec using static SAK security mode.</p> <p>If you are configuring a MAC address on a secure channel in the outbound direction, you should specify the MAC address of the interface as the <b>mac-address</b>.</p> <p>If you are configuring a MAC address on a secure channel in the inbound direction, you should specify the MAC address of the interface at the other end of the link as the <b>mac-address</b>.</p> <p>You only use this configuration option when you are configuring MACsec using static SAK security mode. This option does not need to be specified when you are enabling MACsec using static connectivity association key (CAK) security mode.</p> |
| <b>Default</b>                  | No MAC address is specified in the secure channel, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <b>mac-address</b> —The MAC address, in six groups of two hexadecimal digits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## mac-learn-enable

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac-learn-enable;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> ]<br>[edit interfaces aex aggregated-ether-options ethernet-switch-profile]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Support for statement under the [edit interfaces aex aggregated-ether-options <b>ethernet-switch-profile</b> ] hierarchy introduced in Junos OS Release 15.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), for Gigabit Ethernet DPCs on MX Series routers, for 100-Gigabit Ethernet Type 5 PIC with CFP, and for MPC3E, MPC4E, MPC5E, MPC5EQ, and MPC6E MPCs, configure dynamic learning of the source and destination MAC addresses. By default, the interface is not allowed to dynamically learn source and destination MAC addresses.</p> <p>To disable dynamic learning of the source and destination MAC addresses after it has been configured, you must delete <b>mac-learn-enable</b> from the configuration.</p> <p>MPCs support MAC address accounting for an individual interface or an aggregated Ethernet interface member link only after the interface has received traffic from the MAC source. If traffic is only exiting an interface, the MAC address is not learned and MAC address accounting does not occur.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring MAC Address Filtering on page 465</a></li><li>• <a href="#">Configuring MAC Address Accounting on page 457</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## mac-radius (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mac-radius &lt;flap-on-disconnect&gt; &lt;restrict&gt;;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>]) dot1x]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Configure MAC RADIUS authentication for specific interfaces. MAC RADIUS authentication allows LAN access to permitted MAC addresses. When a new MAC address appears on an interface, the switch consults the RADIUS server to check whether the MAC address is a permitted address. If the MAC address is configured on the RADIUS server, the device is allowed access to the LAN.</p> <p>If MAC RADIUS is configured, the switch first tries to get a response from the host for 802.1X authentication. If the host is unresponsive, the switch attempts to authenticate using MAC RADIUS.</p> <p>To restrict authentication to MAC RADIUS only, use the <b>restrict</b> option. In restrictive mode, all 802.1X packets are eliminated and the attached device on the interface is considered a nonresponsive host.</p> |
| <b>Options</b>                  | <p><b>flap-on-disconnect</b>—(Optional) When the RADIUS server sends a disconnect message to a supplicant, the switch resets the interface on which the supplicant is authenticated. If the interface is configured for multiple supplicant mode, the switch resets all the supplicants on the specified interface. This option takes effect only when the <b>restrict</b> option is also set.</p> <p><b>restrict</b>—(Optional) Restricts authentication to MAC RADIUS only. When <b>mac-radius restrict</b> is configured the switch drops all 802.1X packets. This option is useful when no other 802.1X authentication methods, such as guest VLAN, are needed on the interface, and eliminates the delay that occurs while the switch determines that a connected device is a non-802.1X-enabled host.</p>               |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## mac-validate

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | mac-validate (loose   strict);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>family</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Enable IP and MAC address validation for static Ethernet, IP demux interfaces, and VLAN demux interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <p><b>loose</b>—Forwards incoming packets when both the IP source address and the MAC source address match one of the trusted address tuples. Drops packets when the IP source address matches one of the trusted tuples, but the MAC address does not match the MAC address of the tuple. Continues to forward incoming packets when the source address of the incoming packet does not match any of the trusted IP addresses.</p> <p><b>strict</b>—Forwards incoming packets when both the IP source address and the MAC source address match one of the trusted address tuples. Drops packets when the MAC address does not match the tuple's MAC source address, or when IP source address of the incoming packet does not match any of the trusted IP addresses.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">MAC Address Validation on Static Ethernet Interfaces Overview on page 231</a></li><li>• <i>Configuring an IP Demultiplexing Interface</i></li><li>• <i>Configuring a VLAN Demultiplexing Interface</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## macsec (MX Series)

```

Syntax  macsec {
            connectivity-association connectivity-association-name {
                exclude-protocol protocol-name;
                include-sci;
                mka {
                    must-secure;
                    key-server-priority priority-number;
                    transmit-interval interval;
                }
                no-encryption;
                offset (0|30|50);
                pre-shared-key {
                    cak hexadecimal-number;
                    ckn hexadecimal-number;
                }
                replay-protect{
                    replay-window-size number-of-packets;
                }
                secure-channel secure-channel-name {
                    direction (inbound | outbound);
                    encryption ;
                    id {
                        mac-address mac-address;
                        port-id port-id-number;
                    }
                    offset (0|30|50);
                    security-association security-association-number {
                        key key-string;
                    }
                }
                security-mode security-mode;
            }
            interfaces interface-name {
                connectivity-association connectivity-association-name;
            }
        }

```

**Hierarchy Level** [edit security]

**Release Information** Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description** Configure Media Access Control Security (MACsec) on MX Series routers.

**Options** The remaining statements are explained separately.

**Required Privilege Level** admin—To view this statement in the configuration.  
admin-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring Media Access Control Security \(MACsec\) on MX Series Routers on page 93](#)

## maintenance-association

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> maintenance-association <i>ma-name</i> {   <b>short-name-format</b> (character-string   vlan   2octet   rfc-2685-vpn-id);   <b>protect-maintenance-association</b> <i>protect-ma-name</i>;   <b>remote-maintenance-association</b> <i>remote-ma-name</i>;   <b>continuity-check</b> {     <b>hold-interval</b> <i>minutes</i>;     <b>interval</b> (10m   10s   1m   1s   100ms);     <b>loss-threshold</b> <i>number</i>;   }   <b>mep</b> <i>mep-id</i> {     <b>auto-discovery</b>;     <b>direction</b> (up   down);     <b>interface</b> <i>interface-name</i> (protect   working);     <b>lowest-priority-defect</b> (all-defects   err-xcon   mac-rem-err-xcon   no-defect         rem-err-xcon   xcon );     <b>priority</b> <i>number</i>;     <b>remote-mep</b> <i>mep-id</i> {       <b>action-profile</b> <i>profile-name</i>;       <b>sla-iterator-profile</b> <i>profile-name</i> {         <b>data-tlv-size</b> <i>size</i>;         <b>iteration-count</b> <i>count-value</i>;         <b>priority</b> <i>priority-value</i>;       }     }   } } </pre> |
| <b>Hierarchy Level</b>          | [edit protocols <b>oam</b> <b>ethernet connectivity-fault-management maintenance-domain</b> <i>domain-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | Configure the name of the maintenance association in IEEE-compliant format.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <b>ma-name</b> —The name of the maintenance association within the maintenance domain.<br><br>The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Creating a Maintenance Association on page 528</a></li> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> <li>• <a href="#">Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



## maintenance-domain

**Syntax** `maintenance-domain domain-name {`  
     `bridge-domain name <vlan-id [ vlan-ids ]>;`  
     `instance vpls-instance-name;`  
     `level number;`  
     `maintenance-association ma-name {`  
         `protect-maintenance-association protect-ma-name;`  
         `remote-maintenance-association remote-ma-name;`  
         `short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);`  
         `continuity-check {`  
             `hold-interval minutes;`  
             `interval (10m | 10s | 1m | 1s | 100ms);`  
             `loss-threshold number`  
         `}`  
     `mep mep-id {`  
         `auto-discovery;`  
         `direction (up | down);`  
         `interface interface-name (protect | working);`  
         `lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect |`  
             `rem-err-xcon | xcon );`  
         `priority number;`  
         `remote-mep mep-id {`  
             `action-profile profile-name;`  
             `sla-iterator-profile profile-name {`  
                 `data-tlv-size size;`  
                 `iteration-count count-value;`  
                 `priority priority-value;`  
             `}`  
         `}`  
     `}`  
     `mip-half-function(none | default | explicit);`  
     `name-format (character-string | none | dns | mac+2oct);`  
     `}`  
     `virtual-switch name {`  
         `bridge-domain name <vlan-id [ vlan-ids ]>;`  
     `}`  
`}`

**Hierarchy Level** [edit protocols `oam ethernet connectivity-fault-management`]

**Release Information** Statement introduced in Junos OS Release 8.4.  
 Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.  
 Support for multiple down MEP introduced in Junos OS Release 15.1R1 for MX Series Routers.

**Description** Configure the name of the maintenance domain in IEEE-compliant format.



**NOTE:** For MX Series Routers, you can configure multiple down MEPs for a single instance of maintenance domain identifier and maintenance

association name to monitor services provided on Virtual Private LAN Service (VPLS), bridge, circuit cross-connect (CCC), and IPv4 domains.

.....

**Options**    *domain-name*—Name of the maintenance domain.

The remaining statements are explained separately.

**Required Privilege Level**    interface—To view this statement in the configuration.  
                                         interface-control—To add this statement to the configuration.

**Related Documentation**

- [Creating a Maintenance Domain on page 525](#)
- [Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530](#)
- [Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers](#)

---

## major-ring-name

---

**Syntax**    major-ring-name *name*;

**Hierarchy Level**    [edit protocols [protection-group ethernet-ring](#) *ring-name*]

**Release Information**    Statement introduced in Junos OS Release 14.2.

**Description**    Specify the name of major ring to which the sub-ring node is interconnected.

**Required Privilege Level**    interface—To view this statement in the configuration.  
                                         interface-control—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Configuring Ethernet Ring Protection Switching \(CLI Procedure\)](#)

## manual switch

---

|                                 |                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | request protection-group ethernet-aps manual-switch md <md> ma <ma>                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit protocols protection-group ethernet-aps]                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | Forces traffic to switch from the active path to the alternate path, even in the absence of a failure on the working path. If the working path is the active path, traffic will be switched to the protection path. If the protection path is the active path, traffic will be switched to the protection path. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Automatic Protection Switching Overview on page 205</a></li> </ul>                                                                                                                                                                                |

## master-only

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | master-only;                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit groups rex interfaces (fxp0   em0) unit <i>logical-unit-number</i> family <i>family</i> address],<br>[edit groups rex logical-systems <i>logical-system-name</i> interfaces fxp0 unit <i>logical-unit-number</i> family <i>family</i> address],<br>[edit interfaces (fxp0   em0) unit <i>logical-unit-number</i> family <i>family</i> address],<br>[edit logical-systems <i>logical-system-name</i> interfaces fxp0 unit <i>logical-unit-number</i> family <i>family</i> address] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 11.1 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | Configure the IP address to be used when the Routing Engine is the current master.                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a Consistent Management IP Address on page 26</a></li> <li>• <i>CLI User Guide</i></li> </ul>                                                                                                                                                                                                                                                                                                                          |

## max-sessions (PPPoE Service Name Tables)

---


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>max-sessions <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | <code>[edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i>]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Configure the maximum number of active PPPoE sessions using either static or dynamic PPPoE interfaces that the router can establish with the specified named service, <b>empty</b> service, or <b>any</b> service entry in a PPPoE service name table. The router maintains a count of active PPPoE sessions for each service entry to determine when the maximum sessions limit has been reached.</p> <p>The router uses the <b>max-sessions</b> value for a PPPoE service name table entry in conjunction with the <b>max-sessions</b> value configured for the PPPoE underlying interface, and with the maximum number of PPPoE sessions supported on your router. If your configuration exceeds any of these maximum session limits, the router is unable to establish the PPPoE session.</p> |
| <b>Options</b>                  | <p><b><i>number</i></b>—Maximum number of active PPPoE sessions that the router can establish with the specified PPPoE service name table entry, in the range 1 to the platform-specific maximum PPPoE sessions supported for your router. The default value is equal to the maximum number of PPPoE sessions supported on your routing platform.</p> <p>For information about scaling values for PPPoE interfaces, access the <i>Subscriber Management Scaling Values (XLS)</i> spreadsheet from the Downloads box on the <i>Junos OS Subscriber Management</i> pathway page for the current release.</p>                                                                                                                                                                                           |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Limiting the Number of Active PPPoE Sessions Established with a Specified Service Name</i></li><li>• <i>Configuring PPPoE Service Name Tables</i></li><li>• <i>PPPoE Maximum Session Limit Overview</i></li><li>• <i>Configuring an Interface Set of Subscribers in a Dynamic Profile</i></li><li>• <i>Subscriber Interfaces and PPPoE Overview</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                             |

## max-sessions-vsa-ignore (Static and Dynamic Subscribers)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | max-sessions-vsa-ignore;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | <p>[edit dynamic-profiles <i>profile-name</i> interfaces demux0 unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit dynamic-profiles <i>profile-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit dynamic-profiles <i>profile-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> pppoe-underlying-options],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> pppoe-underlying-options],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> pppoe-underlying-options]</p> |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | <p>Configure the router to ignore (clear) the value returned by RADIUS in the Max-Clients-Per-Interface Juniper Networks vendor-specific attribute (VSA) [26-143], and restore the PPPoE maximum session value on the underlying interface to the value configured in the CLI with the <b>max-sessions</b> statement. The PPPoE maximum session value specifies the maximum number of concurrent static or dynamic PPPoE logical interfaces (sessions) that the router can activate on the PPPoE underlying interface, or the maximum number of active static or dynamic PPPoE sessions that the router can establish with a particular service entry in a PPPoE service name table.</p>                                                                                                                                                                                                            |
| <b>Default</b>                  | If you do not include the <b>max-sessions-vsa-ignore</b> statement, the maximum session value returned by RADIUS in the Max-Clients-Per-Interface VSA takes precedence over the PPPoE maximum session value configured with the <b>max-sessions</b> statement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Limiting the Maximum Number of PPPoE Sessions on the Underlying Interface</i></li> <li>• <i>PPPoE Maximum Session Limit Overview</i></li> <li>• <i>Guidelines for Using PPPoE Maximum Session Limit from RADIUS</i></li> <li>• <i>Juniper Networks VSAs Supported by the AAA Service Framework</i></li> <li>• <i>Configuring an Interface Set of Subscribers in a Dynamic Profile</i></li> <li>• <i>Subscriber Interfaces and PPPoE Overview</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                             |

## maximum-links

---

|                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                          | <code>maximum-links <i>maximum-links-limit</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>                                                                                                                                                                                 | [edit chassis <a href="#">aggregated-devices</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>                                                                                                                                                                             | <p>Statement introduced in Junos OS Release 11.1 for T Series routers.</p> <p>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.</p> <p>Statement introduced in Junos OS Release 12.3 for MX Series routers.</p>                                                                                                                                                                                                                         |
| <b>Description</b>                                                                                                                                                                                     | <p>Configure the maximum links limit for aggregated devices. Note that for MX Series routers, to set a range of 32 or 64 the router must be running in Enhanced IP mode, which is only supported for Trio-based MPCs and multiservice DPCs (MS-DPCs). For more information on Enhanced IP mode, <i>Network Services Mode Overview</i>.</p> <p>For MX series routers and PTX series switches, the option for 64 links is only supported for Junos OS release 12.3 and later.</p> |
| <div> <b>NOTE:</b> This statement is not supported on the MX80 router and the PTX1000 packet transport router.</div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                                                                                                                                                                                         | <p><i>maximum-links-limit</i>—Maximum links limit for aggregated devices.</p> <p><b>Range:</b> 16, 32, 64</p>                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b>                                                                                                                                                                        | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>                                                                                                                                                                           | <ul style="list-style-type: none"><li>• <i>Network Services Mode Overview</i></li><li>• <a href="#">Configuring Junos OS for Supporting Aggregated Devices on page 140</a></li><li>• <a href="#">Configuring an Aggregated Ethernet Interface on page 126</a></li><li>• <i>network-services</i></li></ul>                                                                                                                                                                       |

## maximum-requests

|                                 |                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | maximum-requests <i>times</i> ;                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols dot1x authenticator interface <i>interface-id</i> ]                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify the maximum number of retransmission times of an EAPOL Request packet to the client before it times out the authentication session.                                                                                                                                                             |
| <b>Options</b>                  | <i>times</i> —Specify the maximum number of retransmission times.<br><b>Range:</b> 1 through 10 times<br><b>Default:</b> 2 times                                                                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authenticator on page 881</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> </ul> |

## maximum-requests (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | maximum-requests <i>number</i> ;                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ]) dot1x]                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                  |
| <b>Description</b>              | For 802.1X authentication, configure the maximum number of times an EAPOL request packet is retransmitted to the supplicant before the authentication session times out. |
| <b>Default</b>                  | Two retransmission attempts                                                                                                                                              |
| <b>Options</b>                  | <i>number</i> —Number of retransmission attempts.<br><b>Range:</b> 1 through 10<br><b>Default:</b> 2                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                      |

## mc-ae

**Syntax**

```
mc-ae {
  chassis-id chassis-id;
  events {
    iccp-peer-down;
    force-icl-down;
    prefer-status-control-active;
  }
  init-delay-time seconds;
  mc-ae-id mc-ae-id;
  mode (active-active | active-standby);
  redundancy-group group-id;
  status-control (active | standby);
  switchover-mode (non-revertive | revertive);
}
```

**Hierarchy Level** [edit interfaces aeX aggregated-ether-options],  
[edit logical-systems *logical-system-name* interfaces aeX aggregated-ether-options]

**Release Information** Statement introduced in Junos OS Release 9.6 for MX Series routers.  
**events** statement introduced in Junos OS Release 11.4R4 for MX Series routers.  
 Statement introduced in Junos OS Release 12.3R2 for EX Series switches.  
**prefer-status-control-active** statement introduced in Junos OS Release 13.2R1 for EX Series switches.  
**init-delay-time seconds** statement introduced in Junos OS Release 13.2R3 for EX Series switches.  
 Statement introduced in Junos OS Release 12.2 for the QFX Series. Only the **chassis-id**, **mc-ae-id**, **mode active-active**, and **status-control (active | standby)** options are supported on QFX Series devices.

**Description** Enable multichassis link aggregation groups (MC-LAGs), which enables one device to form a logical LAG interface with two or more other devices.

**Options** **chassis-id *chassis-id***—Specify the chassis ID for Link Aggregation Control Protocol (LACP) to calculate the port number of MC-LAG physical member links.

**Values:** 0 or 1

**events**—Specify an action if a specific MC-LAG event occurs.

**iccp-peer-down**—Specify an action if the ICCP peer of this node goes down.

**force-icl-down**—If the node's ICCP peer goes down, bring down the interchassis-link logical interface.

**prefer-status-control-active**—Specify that the node configured as **status-control active** become the active node if the peer of this node goes down.



**BEST PRACTICE:** We recommend that you configure **prefer-status-control-active** statement with the **mc-ae status-control active** configuration. Do not configure the



**prefer-status-control-active** statement with the **mc-ae status-control standby** configuration.



**NOTE:** If you configure both nodes as **prefer-status-control-active**, you must also configure ICCP peering using the peer's loopback address to make sure that the ICCP session does not go down because of physical link failures. Additionally, you must configure backup liveness detection on both of the MC-LAG nodes.

**init-delay-time seconds**—To minimize traffic loss, specify the number of seconds in which to delay bringing the multichassis aggregated Ethernet interface back to the up state when you reboot an MC-LAG peer.

**mc-ae-id mc-ae-id**—Specify the identification number of the MC-LAG device. The two MC-LAG network devices that manage a given MC-LAG must have the same identification number.

**Range:** 1 through 65,535

**mode (active-active | active-standby)**—Specify whether the MC-LAG is in active-active or active-standby mode.



**NOTE:** You can configure IPv4 (inet) and IPv6 (inet6) addresses on **mc-ae** interfaces when the active-standby mode is configured.

**redundancy-group group-id**—Specify the redundancy group identification number. The Inter-Chassis Control Protocol (ICCP) uses the redundancy group ID to associate multiple chassis that perform similar redundancy functions.

**Range:** 1 through 4,294,967,294

**revert-time**—Wait interval (in minutes) before the switchover to the preferred node is performed when the **switchover-mode** is configured as revertive.

**Range:** 1 through 10

**status-control (active | standby)**—Specify whether the chassis becomes active or remains in standby mode when an interchassis link failure occurs.

**switchover-mode (non-revertive | revertive)**—Specify whether Junos OS should trigger a link switchover to the preferred node when the active node is available.



**NOTE:** For revertive mode to automatically switch over to the preferred node, the **status-control** statement needs to be configured as active.

|                                 |                                                                                                                                                                                                                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Active-Active Bridging and VRRP over IRB Functionality Overview</i></li><li>• <i>Configuring Multichassis Link Aggregation on MX Series Routers</i></li><li>• <i>Configuring Multichassis Link Aggregation on EX Series Switches</i></li></ul> |

---

## measurement-type

---

|                                 |                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | measurement-type (loss   statistical-loss-measurement   two-way-delay);                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles</a> <i>profile-name</i> ]                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.1.<br>The <b>statistical-loss-measurement</b> option introduced in Junos OS Release 11.2.                                                                                                                                                                              |
| <b>Description</b>              | Configure the measurement type for the service level agreement (SLA) frames. An SLA frame is a type of packet used to measure frame loss in Ethernet connections.                                                                                                                                                  |
| <b>Options</b>                  | <b>loss</b> —Use Y.1731-compliant line module (LM) frames to measure frame loss.<br><br><b>statistical-loss-measurement</b> — Use Y.1731-compliant two-way data module (DM) frames to statistically measure frame loss.<br><br><b>two-way-delay</b> —Use Y.1731-compliant two-way DM frames to measure frame loss. |
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li></ul>                                                                                                                                                                                                      |

## mep

|                                 |                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> mep mep-id {   action-profile action-profile-name   auto-discovery;   direction (up   down);   interface interface-name (protect   working);   priority number;   remote-mep mep-id {     action-profile profile-name;     sla-iterator-profile profile-name {       data-tlv-size size;       iteration-count count-value;       priority priority-value;     }   } } </pre> |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name</a> ]                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | The numeric identifier of the maintenance association end point (MEP) within the maintenance association.                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | <p><b>mep mep-id</b>—Specify the numeric identifier of the MEP.</p> <p><b>Range:</b> 1 through 8191</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li> <li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> </ul>                                                      |

## minimum-bandwidth (aggregated Ethernet)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | minimum-bandwidth bw-unit <i>unit</i> bw-value <i>value</i> ;                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit interfaces aex aggregated-ether-options]                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 14.1R1 and 14.2 for MX Series.                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | Configure the minimum bandwidth unit for an aggregated Ethernet bundle as bps, Gbps, Kbps, or Mbps and the bandwidth value from 1 through 128,000.                                                                                                                                                                                                |
| <b>Options</b>                  | <p><b><i>unit</i></b>—Minimum bandwidth unit for the aggregated Ethernet bundle as bps, Gbps, Kbps, or Mbps.</p> <p><b><i>value</i></b>—Minimum bandwidth value from 1 through 128,000.</p>                                                                                                                                                       |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Aggregated Ethernet Interfaces Overview on page 122</a></li><li>• <a href="#">Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 129</a></li><li>• <a href="#">Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 136</a></li></ul> |

## minimum-links

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>minimum-links <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | <code>[edit interfaces aex <a href="#">aggregated-ether-options</a>],</code><br><code>[edit interfaces aex aggregated-sonet-options],</code><br><code>[edit interfaces <i>interface-name</i> mlfr-uni-nni-bundle-options],</code><br><code>[edit interfaces <i>interface-name</i> <a href="#">unit logical-unit-number</a>],</code><br><code>[edit interfaces interface-range <i>range</i> <a href="#">aggregated-ether-options</a>],</code><br><code>[edit interfaces interface-range <i>range</i> aggregated-sonet-options],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <a href="#">unit logical-unit-number</a>]</code>                                                                                                                                                                   |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | For aggregated Ethernet, SONET/SDH, multilink, link services, and voice services interfaces only, set the minimum number of links that must be up for the bundle to be labeled up.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b><i>number</i></b>—Number of links.</p> <p><b>Range:</b> On M120, M320, MX Series, T Series, and TX Matrix routers with Ethernet interfaces, the valid range for minimum-links number is 1 through 64. When the maximum value (16) is specified, all configured links of a bundle must be up for the bundle to be labeled up. On all other routers and on EX Series switches, other than EX8200 switches, the range of valid values for minimum-links number is 1 through 8. When the maximum value (8) is specified, all configured links of a bundle must be up for the bundle to be labeled up. On EX8200 switches, the range of valid values for minimum-links number is 1 through 12. When the maximum value (12) is specified, all configured links of a bundle must be up for the bundle to be labeled up.</p> <p><b>Default:</b> 1</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Aggregated Ethernet Minimum Links on page 145</a></li> <li>• <a href="#">Configuring Aggregated SONET/SDH Interfaces</a></li> <li>• <a href="#">Configuring Aggregated Ethernet Links (CLI Procedure)</a></li> <li>• <a href="#">Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch</a></li> <li>• <a href="#">Junos OS Services Interfaces Library for Routing Devices</a></li> </ul>                                                                                                                                                                                                                                                                                  |

## mip-half-function

---

|                            |                                                                                                                                                                                                                        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | mip-half-function (none   default   explicit);                                                                                                                                                                         |
| <b>Hierarchy Level</b>     | [edit protocols <a href="#">oam ethernet connectivity-fault-managementmaintenance-domain md-name</a> ],<br>[edit protocols <a href="#">oam ethernet connectivity-fault-managementmaintenance-association ma-name</a> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                          |
| <b>Description</b>         | Specify the OAM Ethernet CFM maintenance domain MIP half functions.                                                                                                                                                    |



**NOTE:** Whenever a MIP is configured and a bridge domain is mapped to multiple maintenance domains or maintenance associations, it is essential that the `mip-half-function` value for all maintenance domains and maintenance associations are the same.

|                                 |                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Options</b>                  | <b>none</b> —Specify to not use the mip-half-function.<br><b>default</b> —Specify to use the default mip-half-function.<br><b>explicit</b> —Specify an explicit mip-half-function. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Creating a Maintenance Domain on page 525</a></li><li>• <a href="#">maintenance-domain on page 1053</a></li></ul>              |

## mixed-rate-mode

|                                 |                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>mixed-rate-mode;</code>                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit chassis fpc slot-number pic pic-number mixed-rate-mode]</code> ,<br><code>[edit chassis lcc number fpc slot-number pic pic-number mixed-rate-mode]</code> (Routing Matrix)                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.3.                                                                                                                                                              |
| <b>Description</b>              | Configure the mixed-rate mode for the 24-port 10 Gigabit Ethernet PIC (PF-24XGE-SFPP) only.                                                                                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Modes of Operation of 10-Gigabit Ethernet PICs on page 365</a></li> <li>• <a href="#">Configuring Mixed-Rate Mode Operation on page 370</a></li> </ul> |

## mka (MX Series)

|                                 |                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> mka {   must-secure;   key-server-priority <i>priority-number</i>;   transmit-interval <i>interval</i>; } </pre>                                 |
| <b>Hierarchy Level</b>          | <code>[edit security macsec connectivity-association <i>connectivity-association-name</i>]</code>                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                     |
| <b>Description</b>              | Specify parameters for the MACsec Key Agreement (MKA) protocol.                                                                                        |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                     |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul> |

## monitor-end-point

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (monitor-end-point   no-monitor-end-point);                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> <a href="#">odu-delay-management</a> ]                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Originate or do not originate the connection monitor end point.                                                                                                                                                   |
| <b>Default</b>                  | By default, do not originate the connection monitor end point.                                                                                                                                                    |
| <b>Options</b>                  | <b>monitor-end-point</b> —Originate the connection monitor end point.<br><b>no-monitor-end-point</b> —Do not originate the connection monitor end point.                                                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |



## must-secure (MX Series)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>must-secure;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | <code>[edit security macsec connectivity-association <i>connectivity-association-name</i> mka]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Specifies that all traffic travelling on the MACsec-secured link must be MACsec-secured to be forwarded onward.</p> <p>When the <b>must-secure</b> option is enabled, all traffic that is not MACsec-secured that is received on the interface is dropped.</p> <p>When the <b>must-secure</b> option is disabled, all traffic from devices that support MACsec is MACsec-secured while traffic received from devices that do not support MACsec is forwarded through the network.</p> <p>The <b>must-secure</b> option is particularly useful in scenarios where multiple devices, such as a phone and a PC, are accessing the network through the same Ethernet interface. If one of the devices supports MACsec while the other device does not support MACsec, the device that doesn't support MACsec can continue to send and receive traffic over the network—provided the <b>must-secure</b> option is disabled—while traffic to and from the device that supports MACsec is MACsec-secured. In this scenario, traffic to the device that is not MACsec-secured must be VLAN-tagged.</p> |
| <b>Default</b>                  | The <b>must-secure</b> option is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## mtu

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>mtu bytes;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>     | <p>[edit interfaces <i>interface-name</i>],</p> <p>[edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>family</i>],</p> <p>[edit interfaces <i>interface-range name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>family</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> protocols l2circuit local-switching interface <i>interface-name</i> backup-neighbor <i>address</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i> backup-neighbor <i>address</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols l2vpn interface <i>interface-name</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> protocols vpls],</p> <p>[edit protocols l2circuit local-switching interface <i>interface-name</i> backup-neighbor <i>address</i>],</p> <p>[edit protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i>],</p> <p>[edit protocols l2circuit neighbor <i>address</i> interface <i>interface-name</i> backup-neighbor <i>address</i>],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols l2vpn interface <i>interface-name</i>],</p> <p>[edit routing-instances <i>routing-instance-name</i> protocols vpls]</p> |
| <b>Release Information</b> | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Support for Layer 2 VPNs and VPLS introduced in Junos OS Release 10.4.</p> <p>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.</p> <p>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.</p> <p>Support at the [set interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>ccc</i>] hierarchy level introduced in Junos OS Release 12.3R3 for MX Series routers.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>         | <p>Specify the maximum transmission unit (MTU) size for the media or protocol. The default MTU size depends on the device type. Changing the media MTU or protocol MTU causes an interface to be deleted and added again.</p> <p>To route jumbo data packets on an integrated routing and bridging (IRB) interface or routed VLAN interface (RVI) on EX Series switches, you must configure the jumbo MTU size on the member physical interfaces of the VLAN that you have associated with the IRB interface or RVI, as well as on the IRB interface or RVI itself (the interface named <i>irb</i> or <i>vlan</i>, respectively).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



**CAUTION:** For EX Series switches, setting or deleting the jumbo MTU size on an IRB interface or RVI while the switch is transmitting packets might cause packets to be dropped.



---

**NOTE:**

The MTU for an IRB interface is calculated by removing the Ethernet header overhead [6(DMAC)+6(SMAC)+2(EtherType)]. Because, the MTU is the lower value of the MTU configured on the IRB interface and the MTU configured on the IRB's associated bridge domain IFDs or IFLs, the IRB MTU is calculated as follows:

- In case of Layer 2 IFL configured with the `flexible-vlan-tagging` statement, the IRB MTU is calculated by including 8 bytes overhead (SVLAN+CVLAN).
  - In case of Layer 2 IFL configured with the `vlan-tagging` statement, the IRB MTU is calculated by including a single VLAN 4 bytes overhead.
-



---

**NOTE:**

- If a packet whose size is larger than the configured MTU size is received on the receiving interface, the packet is eventually dropped. The value considered for MRU (maximum receive unit) size is also the same as the MTU size configured on that interface.
- Not all devices allow you to set an MTU value, and some devices have restrictions on the range of allowable MTU values. You cannot configure an MTU for management Ethernet interfaces (fxp0, em0, or me0) or for loopback, multilink, and multicast tunnel devices.
- On ACX Series routers, you can configure the protocol MTU by including the `mtu` statement at the [edit interfaces *interface-name* unit *logical-unit-number* family inet] or [edit interfaces *interface-name* unit *logical-unit-number* family inet6] hierarchy level.
  - If you configure the protocol MTU at any of these hierarchy levels, the configured value is applied to all families that are configured on the logical interface.
  - If you are configuring the protocol MTU for both inet and inet6 families on the same logical interface, you must configure the same value for both the families. It is not recommended to configure different MTU size values for inet and inet6 families that are configured on the same logical interface.
- For IRB interfaces, MTU is calculated by removing the Ethernet header overhead ( $6(\text{DMAC}) + 6(\text{SMAC}) + 2(\text{EtherType})$ ), and the MTU is a minimum of the two values:
  - Configured MTU
  - Associated bridge domain's physical or logical interface MTU
    - For Layer 2 logical interfaces configured with flexible-vlan-tagging, IRB MTU is calculated by including 8 bytes overhead (SVLAN+CVLAN).
    - For Layer 2 logical interfaces configured with vlan-tagging, IRB MTU is calculated by including single VLAN 4 bytes overhead.



---

**NOTE:** Changing the Layer 2 logical interface option from vlan-tagging to flexible-vlan-tagging or vice versa adjusts the logical interface MTU by 4 bytes with the existing MTU size. As a result, the Layer 2 logical interface is deleted and re-added, and the IRB MTU is re-computed appropriately.

---

For more information about configuring MTU for specific interfaces and router or switch combinations, see *OBSOLETE: Configuring the Media MTU*.

**Options**    *bytes*—MTU size.

**Range:** 256 through 9192 bytes, 256 through 9216 (EX Series switch interfaces), 256 through 9500 bytes (Junos OS 12.1X48R2 for PTX Series routers)


**Default:** 1500 bytes (INET, INET6, and ISO families), 1448 bytes (MPLS), 1514 bytes (EX Series switch interfaces)

**Required Privilege**    interface—To view this statement in the configuration.


**Level**    interface-control—To add this statement to the configuration.

- Related Documentation**
- *OBSOLETE: Configuring the Media MTU*
  - *Configuring the MTU for Layer 2 Interfaces*
  - *OBSOLETE-Setting the Protocol MTU*

## multicast-router-interface (IGMP Snooping)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | multicast-router-interface;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>[edit bridge-domains <i>bridge-domain-name</i> protocols <b>igmp-snooping</b> interface <i>interface-name</i>],</p> <p>[edit bridge-domains <i>bridge-domain-name</i> protocols <b>igmp-snooping</b> vlan <i>vlan-id</i> interface <i>interface-name</i>],</p> <p>[edit protocols <b>igmp-snooping</b> vlan (all   <i>vlan-name</i>) interface (all   <i>interface-name</i>)],</p> <p>[edit routing-instances <i>routing-instance-name</i> bridge-domains <i>bridge-domain-name</i> protocols <b>igmp-snooping</b> interface <i>interface-name</i>],</p> <p>[edit routing-instances <i>routing-instance-name</i> bridge-domains <i>bridge-domain-name</i> protocols vlan <i>vlan-id</i> <b>igmp-snooping</b> interface <i>interface-name</i>]</p> |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Statement introduced in Junos OS Release 8.5.</p> <p>Statement introduced in Junos OS Release 9.1 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>Statically configure the interface as an IGMP snooping multicast-router interface—that is, an interface that faces toward a multicast router or other IGMP querier.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <div>  <p><b>NOTE:</b> If the specified interface is a trunk port, the interface becomes a multicast-routing device interface for all VLANs configured on the trunk port. In addition, all unregistered multicast packets, whether they are IPv4 or IPv6 packets, are forwarded to the multicast routing device interface, even if the interface is configured as a multicast routing device interface only for IGMP snooping.</p> <p>Configure an interface as a bridge interface toward other multicast routing devices.</p> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Default</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | The interface can either be a host-side or multicast-routing device interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• <i>Example: Configuring IGMP Snooping</i></li> <li>• <i>IGMP Snooping in MC-LAG Active-Active Mode</i></li> <li>• <i>host-only-interface</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## multi-chassis-protection

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>multi-chassis-protection {   peer a.b.c.d {     interface interface-name;   } }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | <p>For MX Series routers with multichassis aggregated Ethernet (MC-AE) interfaces, you can use this statement under the physical interface level to reduce the configuration at the logical interface level if the following assumption exists:</p> <p>If there are <math>n + 1</math> logical interfaces under <b>ae0</b>, from <b>ae0.0</b> through <b>ae0.n</b>, there will be <math>n + 1</math> logical interfaces under <b>ge-0/0/0</b> as well, from <b>ge-0/0/0.0</b> through <b>ge-0/0/0.n</b>, and each <b>ge-0/0/0</b> logical interface will be a protection link for the <b>ae0</b> logical interface.</p> <hr/> <div>  <p><b>NOTE:</b> A bridge domain cannot have MC-AE logical interfaces which belong to different redundancy groups.</p> </div> <hr/> <p>If the Inter-Chassis Control Protocol (ICCP) connection is UP and the interchassis data link (ICL) comes UP, the router configured as standby will bring up the MC-AE interfaces shared with the peer.</p> <p>The remaining statements are explained separately.</p> |
| <b>Options</b>                  | <b>interface <i>interface-name</i></b> —Specify the interface: <b>interface <i>interface-name-fpc/pic/port</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Multichassis Link Aggregation on MX Series Routers</a></li> <li>• <a href="#">Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation</a></li> <li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li> <li>• <a href="#">Example: Configuring Aggregated Ethernet Link Protection on page 158</a></li> <li>• <a href="#">peer on page 1110</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |


## name-format

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | name-format (character-string   none   dns   mac+2oct);                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management <b>maintenance-domain</b> domain-name]                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                                                                                                                                                                         |
| <b>Description</b>              | Specify the format of the maintenance domain name.                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <b>character-string</b> —The name is an ASCII character string.<br><b>none</b> —The maintenance domain name is not used.<br><b>dns</b> —The name is in domain name service (DNS) format. For example: www.juniper.net.<br><b>mac+2oct</b> —Name is the MAC address plus a two-octet maintenance association identifier.<br>For example: 08:00:22:33:44:55.100.<br><b>Default:</b> character-string |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Creating a Maintenance Association on page 528</a></li><li>• <i>Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</i></li></ul>                                                                                                                                                                                          |



## native-vlan-id

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>native-vlan-id <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>     | [edit interfaces <i>ge-fpc/pic/port</i> ],<br>[edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b> | Statement introduced in Junos OS Release 8.3.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>         | <p>Configure mixed tagging support for untagged packets on a port for the following:</p> <ul style="list-style-type: none"> <li>• M Series routers with Gigabit Ethernet IQ PICs with SFP and Gigabit Ethernet IQ2 PICs with SFP configured for 802.1Q flexible VLAN tagging</li> <li>• MX Series routers with Gigabit Ethernet DPCs and MICs, Tri-Rate Ethernet DPCs and MICs, and 10-Gigabit Ethernet DPCs and MICs and MPCs configured for 802.1Q flexible VLAN tagging</li> <li>• T4000 routers with 100-Gigabit Ethernet Type 5 PIC with CFP</li> <li>• EX Series switches with Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces</li> </ul> <p>When the <b>native-vlan-id</b> statement is included with the <b>flexible-vlan-tagging</b> statement, untagged packets are accepted on the same mixed VLAN-tagged port.</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <p> <b>NOTE:</b> The logical interface on which untagged packets are received must be configured with the same VLAN ID as the native VLAN ID configured on the physical interface, otherwise the untagged packets are dropped.</p> </div> <p>To configure the logical interface, include the <b>vlan-id</b> statement (matching the <b>native-vlan-id</b> statement on the physical interface) at the [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>] hierarchy level.</p> <p>When the <b>native-vlan-id</b> statement is included with the <i>interface-mode</i> statement, untagged packets are accepted and forwarded within the bridge domain or VLAN that is configured with the matching VLAN ID.</p> |
| <b>Default</b>             | By default, the untagged packets are dropped. That is, if you do not configure the <b>native-vlan-id</b> option, the untagged packets are dropped.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Options</b>             | <p><b>number</b>—VLAN ID number.</p> <p><b>Range:</b> (ACX Series routers and EX Series switches) 0 through 4094.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Mixed Tagging Support for Untagged Packets on page 239</a></li><li>• <a href="#">Configuring Access Mode on a Logical Interface on page 252</a></li><li>• <i>Configuring the Native VLAN Identifier (CLI Procedure)</i></li><li>• <i>Understanding Bridging and VLANs on EX Series Switches</i></li><li>• <a href="#">flexible-vlan-tagging on page 970</a></li><li>• <i>Understanding Q-in-Q Tunneling on EX Series Switches</i></li></ul> |

---

## negotiate-address

---

|                                 |                                                                                                                                                                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | negotiate-address;                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit <a href="#">interfaces</a> <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">family</a> inet],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">family</a> inet]     |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                          |
| <b>Description</b>              | For interfaces with PPP encapsulation, enable the interface to be assigned an IP address by the remote end.                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring IPCP Options for Interfaces with PPP Encapsulation</i></li><li>• <a href="#">address on page 863</a></li><li>• <a href="#">unnumbered-address (PPP) on page 1234</a></li><li>• <i>Junos OS Administration Library for Routing Devices</i></li></ul> |

## negotiation-options

---

|                                 |                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | negotiation-options {<br><a href="#">allow-remote-loopback</a> ;<br><a href="#">no-allow-link-events</a> ;<br>}                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam link-fault-management interface</a> <i>interface-name</i> ]                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                     |
| <b>Description</b>              | Enable and disable IEEE 802.3ah Operation, Administration, and Management (OAM) features for Ethernet interfaces.<br><br>The statements are explained separately. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.3ah OAM Link-Fault Management Overview on page 594</a></li> </ul>                                   |

## no-adaptive

---

|                                 |                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-adaptive;                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <a href="#">aex aggregated-ether-options load-balance</a> ]                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R3.                                                                                    |
| <b>Description</b>              | Configure no-adaptive on the aggregated Ethernet bundle to remove the adaptive that is configured to address the traffic imbalance. |
| <b>Required Privilege Level</b> | interface - To view statement in the configuration.<br>interface-control - To add this statement to the configuration.              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Understanding Aggregated Ethernet Load Balancing on page 166</a></li> </ul>    |

## no-allow-link-events

---

|                                 |                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-allow-link-events;                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols <b>oam</b> <b>ethernet link-fault-management interface</b> <i>interface-name</i> <b>negotiation-options</b> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                 |
| <b>Description</b>              | Disable the sending of link event TLVs.                                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Disabling the Sending of Link Event TLVs on page 602</a></li></ul>        |

## no-encryption (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-encryption;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Disables MACsec encryption for a connectivity association that is configured to enable MACsec using static connectivity association key (CAK) or dynamic security mode.</p> <p>You can enable MACsec without enabling encryption. If a connectivity association that has not enabled MACsec encryption is associated with an interface, traffic is forwarded across the Ethernet link in clear text. You are, therefore, able to view this unencrypted traffic when you are monitoring the link. The MACsec header is still applied to the packet, however, and all MACsec data integrity checks are run on both ends of the link to ensure the traffic does not represent a security threat.</p> <p>This command is used to disable encryption when MACsec is configured using static CAK or dynamic security mode only. When MACsec is configuring using static secure association key (SAK) security mode, the encryption setting is managed in the secure channel using the <b>encryption</b> configuration statement.</p> |
| <b>Default</b>                  | MACsec encryption is enabled if MACsec is enabled using static CAK or dynamic security mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## no-auto-mdix

|                                 |                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-auto-mdix;                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interface <i>ge-fpc/port/pic</i> <i>gigether-options</i> ]                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.5.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                      |
| <b>Description</b>              | Disable the Auto MDI/MDIX feature.<br><br>MX Series routers with Gigabit Ethernet interfaces automatically detect MDI and MDIX port connections. Use this statement to override the default setting. Remove this statement to return to the default setting. |
| <b>Default</b>                  | Auto MDI/MDIX is enabled by default.                                                                                                                                                                                                                         |
| <b>Options</b>                  | There are no options for this statement.                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Interfaces Overview on page 3</a></li> <li>• <a href="#">gigether-options on page 980</a>.</li> </ul>                                                                                          |

## no-gratuitous-arp-request

|                                 |                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-gratuitous-arp-request;                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6 for EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.        |
| <b>Description</b>              | For Ethernet interfaces and pseudowire logical interfaces, do not respond to gratuitous ARP requests.                                                                 |
| <b>Default</b>                  | Gratuitous ARP responses are enabled on all Ethernet interfaces.                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Gratuitous ARP on page 18</a></li> <li>• <a href="#">gratuitous-arp-reply on page 981</a></li> </ul> |

## no-keepalives

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-keepalives;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ],<br>[edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ]                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p>Disable the sending of keepalives on a physical interface configured with PPP, Frame Relay, or Cisco HDLC encapsulation. The default keepalive interval is 10 seconds.</p> <p>For ATM2 IQ interfaces only, you can disable keepalives on a logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:</p> <ul style="list-style-type: none"><li>• <b>atm-ppp-llc</b>—PPP over AAL5 LLC encapsulation.</li><li>• <b>atm-ppp-vc-mux</b>—PPP over AAL5 multiplex encapsulation.</li></ul> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring Keepalives</i></li><li>• <a href="#">Disabling the Sending of PPPoE Keepalive Messages on page 337</a></li><li>• <i>Configuring Frame Relay Keepalives</i></li></ul>                                                                                                                                                                                                                                                                                                                              |

## no-mac-table-binding (802.1X for MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-mac-table-binding;                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                            |
| <b>Description</b>              | For 802.1X authentication, disable the removal of the session from the authentication session table when the MAC address ages out of the Ethernet switching table. |
| <b>Default</b>                  | Not enabled                                                                                                                                                        |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                |
| <b>Related Documentation</b>    |                                                                                                                                                                    |


## no-odu-backward-frr-enable

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-odu-backward-frr-enable;                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options preemptive-fast-reroute</a> ]                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.<br>Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.                                   |
| <b>Description</b>              | Disable preemptive fast reroute (FRR) ODU backward FRR insertion.                                                                                                                                                    |
| <b>Default</b>                  | By default, FRR ODU backward FRR insertion is disabled.                                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## no-odu-signal-degrade-monitor-enable

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-odu-signal-degrade-monitor-enable;                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options preemptive-fast-reroute</a> ]                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.<br>Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.                                   |
| <b>Description</b>              | Disable monitoring of signal degradation of ODU BER in the received OTN frames.                                                                                                                                      |
| <b>Default</b>                  | By default, FRR signal degrade monitoring disabled.                                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## no-pre-classifier


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-pre-classifier;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit chassis fpc <i>n</i> pic <i>n</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Specify disabling the control queue for all ports on the 10-Gigabit Ethernet LAN/WAN PIC. Deleting this configuration re-enables the control queue feature on all ports of the 10-Gigabit Ethernet LAN/WAN PIC.                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                 | <div>  <p><b>NOTE:</b> For the 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (model number PD-5-10XGE-SFPP), the control queue has a rate limiter to limit the control traffic to 2 Mbps (fixed, not user-configurable) per port. If the transit control traffic crosses this limit, then it can cause drops on locally terminating control traffic, causing flap of protocols such as BGP and OSPF. To avoid the control traffic being dropped, configure the <b>no-pre-classifier</b> statement to disable the control queue.</p> </div> |
| <b>Default</b>                  | The <b>no-pre-classifier</b> statement is not configured and the control queue is operational.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 357</li> <li>Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 366</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                      |

## no-reauthentication (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-reauthentication;                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ]) dot1x]                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.             |
| <b>Description</b>              | For 802.1X authentication, disables reauthentication.                                                               |
| <b>Default</b>                  | Not disabled                                                                                                        |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |



## no-send-pads-ac-info

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-send-pads-ac-info;                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols pppoe]                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | Prevent the router from sending the AC-Name and AC-Cookie tags in the PPPoE Active Discovery Session (PADS) packet. When you configure this statement, it affects PADS packets sent on all PPPoE interfaces configured on the router after the command is issued; it has no effect on previously created PPPoE interfaces. By default, the AC-Name and AC-Cookie tags are transmitted in the PADS packet, along with the Service-Name, Host-Uniq, Relay-Session-Id, and PPP-Max-Payload tags. |
|                                 | <div>  <p><b>NOTE:</b> In Junos OS Release 12.1 and earlier, only the Service-Name, Host-Uniq, Relay-Session-Id, and PPP-Max-Payload tags are contained in the PADS packet by default. The AC-Name and AC-Cookie tags are not transmitted in the PADS packet by default.</p> </div>                                                                                                                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Disabling the Sending of PPPoE Access Concentrator Tags in PADS Packets</li> </ul>                                                                                                                                                                                                                                                                                                                                                                     |

## no-send-pads-error

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | no-send-pads-error;                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols pppoe]                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.3.                                                                          |
| <b>Description</b>              | Discard PADR messages to prevent transmission of PADS control packets with AC-System-Error tags.                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Discarding PADR Messages to Accommodate Abnormal CPE Behavior</li> </ul>         |

## non-revertive (Interfaces)

---

|                                 |                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | non-revertive;                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces aeX aggregated-ether-options lacp link-protection]                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                                                                                                                            |
| <b>Description</b>              | Disable the ability to switch to a better priority link (if one is available) once a link is established as active and collection distribution is enabled.                                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">link-protection on page 1028</a></li><li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li><li>• <a href="#">Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</a></li></ul> |

## non-revertive

---

|                                 |                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | non-revertive;                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                     |
| <b>Description</b>              | Enable nonrevertive operation where traffic is allowed to use the RPL if it has not failed, even after a switch condition has cleared. The default mode of operation is revertive.                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li></ul> |

## non-vc-mode

---

|                                 |                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | non-vc-mode;                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Configure a node on the sub-ring to operate in non-virtual channel mode. If this option is enabled then all the nodes in the sub-ring are configured with this option. Also, the <b>non-vc-mode</b> option should be used with care and only for open rings. Using this option for closed rings creates loops for RAPS control messages. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul>                                                                                                                    |

## node-id

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | node-id <i>mac-address</i> ;                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | <p>For EX Series switches and QFX Series switches, node-id is not configurable.</p> <p>For MX Series routers, optionally specify the MAC address of a node in the protection group. If this statement is not included, the router assigns the node's MAC address.</p>                                                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</a></li> </ul> |

## number-of-frames

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>number-of-frames</code> <i>value</i> ;                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> <a href="#">odu-delay-management</a> ]                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify the number of consequent frames to declare a delay measurement (DM) session completed.                                                                                                                    |
| <b>Options</b>                  | <i>value</i> —Number of consequent frames to declare DM completed.<br><b>Range:</b> 0 through 255 frames.                                                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## offset (MX Series)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | offset (0  30   50);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>     | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]<br>[edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b> | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>         | <p>Specifies the number of octets in an Ethernet frame that are sent in unencrypted plain-text when encryption is enabled for MACsec.</p> <p>Setting the offset to 30 allows a feature to see the IPv4 header and the TCP/UDP header while encrypting the remaining traffic. Setting the offset to 50 allows a feature to see the IPv6 header and the TCP/UDP header while encrypting the remaining traffic.</p> <p>You would typically forward traffic with the first 30 or 50 octets unencrypted if a feature needed to see the data in the octets to perform a function, but you otherwise prefer to encrypt the remaining data in the frames traversing the link. Load balancing features, in particular, typically need to see the IP and TCP/UDP headers in the first 30 or 50 octets to properly load balance traffic.</p> <p>You configure the <b>offset</b> in the [edit security macsec connectivity-association <i>connectivity-association-name</i>] hierarchy when you are enabling MACsec using static connectivity association key (CAK) or dynamic security mode.</p> <p>You configure the <b>offset</b> in the [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i>] hierarchy when you are enabling MACsec using static secure association key (SAK) security mode.</p> |
| <b>Default</b>             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>             | <p><b>0</b>—Specifies that no octets are unencrypted. When you set the offset to 0, all traffic on the interface where the connectivity association or secure channel is applied is encrypted.</p> <p><b>30</b>—Specifies that the first 30 octets of each Ethernet frame are unencrypted.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |



**NOTE:** In IPv4 traffic, setting the offset to 30 allows a feature to see the IPv4 header and the TCP/UDP header while encrypting the rest of the traffic. An offset of 30, therefore, is typically used when a feature needs this information to perform a task on IPv4 traffic.

**50**—Specified that the first 50 octets of each Ethernet frame are unencrypted.



NOTE: In IPv6 traffic, setting the offset to 50 allows a feature to see the IPv6 header and the TCP/UDP header while encrypting the rest of the traffic. An offset of 50, therefore, is typically used when a feature needs this information to perform a task on IPv6 traffic.

**Required Privilege Level** admin—To view this statement in the configuration.  
admin-control—To add this statement to the configuration.

**Related Documentation**

- [Configuring Media Access Control Security \(MACsec\) on MX Series Routers on page 93](#)

## oam

```

Syntax  oam {
    ethernet {
        connectivity-fault-management {
            action-profile profile-name {
                default-actions {
                    interface-down;
                }
            }
        }
        performance-monitoring {
            delegate-server-processing;
            hardware-assisted-timestamping;
            sla-iterator-profiles {
                profile-name {
                    avg-fd-twoway-threshold;
                    avg-ifdv-twoway-threshold;
                    avg-flr-forward-threshold;
                    avg-flr-backward-threshold;
                    disable;
                    calculation-weight {
                        delay delay-weight;
                        delay-variation delay-variation-weight;
                    }
                    cycle-time milliseconds;
                    iteration-period connections;
                    measurement-type (loss | statistical-frame-loss | two-way-delay);
                }
            }
        }
    }
    linktrace {
        age (30m | 10m | 1m | 30s | 10s);
        path-database-size path-database-size;
    }
    maintenance-domain domain-name {
        level number;
        name-format (character-string | none | dns | mac+2octet);
        maintenance-association ma-name {
            short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
            protect-maintenance-association protect-ma-name;
            remote-maintenance-association remote-ma-name;
            continuity-check {
                convey-loss-threshold;
                hold-interval minutes;
                interface-status-tlv;
                interval (100ms | 10m | 10ms | 10s | 1m | 1s);
                loss-threshold number;
                port-status-tlv;
            }
            mep mep-id {
                auto-discovery;
                direction (up | down);
                interface interface-name (protect | working);
            }
        }
    }
}

```

```

lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect |
rem-err-xcon | xcon );
priority number;
remote-mep mep-id {
    action-profile profile-name;
    sla-iterator-profile profile-name {
        data-tlv-size size;
        iteration-count count-value;
        priority priority-value;
    }
}
}
}
}
}
link-fault-management {
    action-profile profile-name {
        action {
            link-down;
            send-critical-event;
            syslog;
        }
        event {
            link-adjacency-loss;
            link-event-rate {
                frame-error count;
                frame-period count;
                frame-period-summary count;
                symbol-period count;
            }
            protocol-down;
        }
    }
}
interface interface-name {
    apply-action-profile
link-discovery (active | passive);
loopback-tracking;
pdu-interval interval;
pdu-threshold threshold-value;
remote-loopback;
event-thresholds {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
}
negotiation-options {
    allow-remote-loopback;
    no-allow-link-events;
}
}
}
}
}
}

```



|                                 |                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hierarchy Level</b>          | [edit protocols]                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                               |
| <b>Description</b>              | For Ethernet interfaces on M320, M120, MX Series, and T Series routers and PTX Series Packet Transport Routers, provide IEEE 802.3ah Operation, Administration, and Maintenance (OAM) support.<br><br>The remaining statements are explained separately. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.3ah OAM Link-Fault Management Overview on page 594</a></li> <li>• <a href="#">Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</a></li> </ul>                       |

## oc192

|                                 |                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | oc192;                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options rate</a> ]                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.3 for MX Series routers.                                                                                                                                                |
| <b>Description</b>              | Set the line rate or speed of the OTN signal to optical channel transport unit 2 (OTU2).                                                                                                                            |
| <b>Options</b>                  | oc192—OTU2 line rate or 10 Gbps                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## odu-delay-management

---

|                                 |                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>odu-delay-management {<br/>    (bypass   no-bypass);<br/>    (monitor-end-point   no-monitor-end-point);<br/>    number-of-frames <i>value</i>;<br/>    (no-start-measurement   start-measurement);<br/>}</code> |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                  |
| <b>Description</b>              | Specify Optical Channel Data Unit (ODU) delay management options.                                                                                                                                                      |
| <b>Default</b>                  | If you omit the odu-delay-management statement, the ODU delay management options are disabled.                                                                                                                         |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul>      |

## odu-backward-frr-enable

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>odu-backward-frr-enable;</code>                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options preemptive-fast-reroute</b> ]                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.<br>Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.                                |
| <b>Description</b>              | Insert the ODU status into the transmitted OTN frames and monitor the received OTN frames for the ODU BER status.                                                                                                 |
| <b>Default</b>                  | By default, FRR ODU backward FRR insertion is disabled.                                                                                                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## odu-signal-degrade

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>odu-signal-degrade {   ber-threshold-clear;   ber-threshold-signal-degrade;   interval }</pre>                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.</p> <p>Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.</p>                                                                                                                                                                                                          |
| <b>Description</b>              | Specify optical channel data unit (ODU) signal degradation threshold-related values.                                                                                                                                                                                                                                                                                                                   |
| <b>Default</b>                  | <p>If you omit the <b>odu-signal-degrade</b> statement, the default threshold values are used.</p> <p>The default threshold values for optical channel data unit (ODU) signal degradation for the P2-100GE-OTN PIC are:</p> <ul style="list-style-type: none"> <li>• <b>ber-threshold-clear</b>—1E-09</li> <li>• <b>ber-threshold-signal-degrade</b>—1E-06</li> <li>• <b>interval</b>—10 ms</li> </ul> |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul>                                                                                                                                                                                   |

## odu-signal-degrade-monitor-enable

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | odu-signal-degrade-monitor-enable;                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options preemptive-fast-reroute</a> ]                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.<br>Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.                                |
| <b>Description</b>              | Enable monitoring of signal degradation of ODU BER in the received OTN frames.                                                                                                                                    |
| <b>Default</b>                  | By default, FRR signal degrade monitoring disabled.                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## odu-ttim-action-enable

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (odu-ttim-action-enable   no-odu-ttim-action-enable);                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify whether consequent action for Optical Channel Data Unit (ODU) TTIM is enabled or disabled.                                                                                                                |
| <b>Default</b>                  | If you omit the odu-ttim-action-enable statement, consequent action for ODU TTIM is disabled.                                                                                                                     |
| <b>Options</b>                  | <b>odu-ttim-action-enable</b> —Enable consequent action for ODU TTIM.<br><b>no-odu-ttim-action-enable</b> —Disable consequent action for ODU TTIM.                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## optics-options

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> <b>optics-options</b> {   <b>alarm</b> low-light-alarm {     (link-down   syslog);   }   <b>tca</b> <i>tca-identifier</i> (enable-tca   no-enable-tca) (threshold <i>number</i>   threshold-24hrs <i>number</i>);   <b>tx-power</b> <i>dbm</i>;   <b>warning</b> low-light-warning {     (link-down   syslog);   }   <b>wavelength</b> <i>nm</i>; } </pre>                                                              |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p><b>alarm</b> option and <b>warning</b> options introduced in Junos OS Release 10.0.</p> <p>Statement introduced in Junos OS Release 12.1 for EX Series switches.</p> <p>Statement and <b>tx-power</b> option introduced in Junos OS Release 13.2 for PTX Series routers.</p> <p><b>tca</b> option introduced in Junos OS Release 14.2 for PTX Series routers.</p> |
| <b>Description</b>              | For 10-Gigabit Ethernet or 100-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) interfaces only, configure full C-band International Telecommunication Union (ITU)-Grid tunable optics.                                                                                                                                                                                                                         |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet DWDM Interface Wavelength Overview on page 381</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> </ul>                                                                                                                                                                                                    |

## otn-options

```
Syntax  otn-options {
    bytes (otn-options) transmit-payload-type value;
    fec (efec | gfec | gfec-sdfec | none );
    (is-ma | no-is-ma);
    (laser-enable | no-laser-enable);
    (line-loopback | no-line-loopback);
    (local-loopback | no-local-loopback);
    (odu-ttim-action-enable | no-odu-ttim-action-enable);
    (otu-ttim-action-enable | no-otu-ttim-action-enable);
    odu-delay-management {
        (bypass | no-bypass);
        (monitor-end-point | no-monitor-end-point);
        number-of-frames value;
        (no-start-measurement | start-measurement;
    }
    odu-signal-degrade {
        ber-threshold-clear value;
        ber-threshold-signal-degrade value;
        interval value;
    }
    (prbs | no-prbs);
    preemptive-fast-reroute {
        (backward-frr-enable | no-backward-frr-enable);
        (signal-degrade-monitor-enable | no-signal-degrade-monitor-enable);
        odu-backward-frr-enable | no-odu-backward-frr-enable;
        odu-signal-degrade-monitor-enable | no-odu-signal-degrade-monitor-enable;
    }
    rate {
        (fixed-stuff-bytes | no-fixed-stuff-bytes);
        oc192;
        otu4;
        (pass-through | no-pass-through);
    }
    signal-degrade {
        ber-threshold-clear value;
        ber-threshold-signal-degrade value;
        interval value;
    }
    tca tca-identifier (enable-tca | no-enable-tca) (threshold number | threshold-24hrs number);
    transport-monitoring;
    trigger trigger-identifier;
    tti tti-identifier;
}
```

Hierarchy Level [edit interfaces ge-fpc/pic/port]  
[edit interfaces xe-fpc/pic/port]  
[edit interfaces et-fpc/pic/port]

Release Information Statement introduced in Junos OS Release 9.4.  
bytes, is-ma, local-loopback, no-is-ma, no-local-loopback, no-odu-ttim-action-enable,  
no-otu-ttim-action-enable, no-prbs, odu-delay-management, odu-ttim-action-enable,

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | <p><b>otu-ttim-action-enable</b>, <b>prbs</b>, <b>preemptive-fast-reroute</b>, and <b>signal-degrade</b> statements introduced in Junos OS Release 13.2 for PTX Series routers.</p> <p><b>oc192</b> statement introduced in Junos OS Release 13.3R3 for MX Series routers.</p> <p><b>odu-signal-degrade</b>, <b>odu-backward-frr-enable   no-odu-backward-frr-enable</b>, <b>odu-signal-degrade-monitor-enable   no-odu-signal-degrade-monitor-enable</b> statements introduced in Junos OS Release 14.1R2 and 14.2 for P2-100GE-OTN PIC in PTX5000 routers.</p> <p><b>tca</b> option introduced in Junos OS Release 14.2 for PTX Series routers.</p> |
| <b>Description</b>              | Specify the Ethernet optical transport network (OTN) interface and options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>interfaces—To view this statement in the configuration.</p> <p>interfaces-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul>                                                                                                                                                                                                                                                                                                                                    |

## otu-ttim-action-enable

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (otu-ttim-action-enable   no-otu-ttim-action-enable);                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                |
| <b>Description</b>              | Specify whether consequent action for Optical Channel Transport Unit (OTU) TTIM is enabled or disabled.                                                                                                              |
| <b>Default</b>                  | If you omit the otu-ttim-action-enable statement, consequent action for OTU TTIM is disabled.                                                                                                                        |
| <b>Options</b>                  | <p><b>otu-ttim-action-enable</b>—Enable consequent action for OTU TTIM.</p> <p><b>no-otu-ttim-action-enable</b>—Disable consequent action for OTU TTIM.</p>                                                          |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## otu4

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | otu4;                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> rate]                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.<br>Statement introduced in Junos OS Release 13.3 for MX Series routers.                                                                     |
| <b>Description</b>              | Sets the line rate or speed of the OTN signal to optical channel transport unit 4 (OTU4).                                                                                                                         |
| <b>Default</b>                  | By default, the rate is OTU4 on PTX Series routers.                                                                                                                                                               |
| <b>Options</b>                  | otu4—OTU4 line rate or 100 Gbps                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |



## output-policer

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>output-policer <i>policer-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Apply a single-rate two-color policer to the Layer 2 output traffic at the logical interface. The <b>output-policer</b> and <b>output-three-color</b> statements are mutually exclusive.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Options</b>                  | <b><i>policer-name</i></b> —Name of the single-rate two-color policer that you define at the [edit firewall] hierarchy level.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Usage Guidelines</b>         | See <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Two-Color and Three-Color Policers at Layer 2</i></li> <li>• <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i></li> <li>• <a href="#">Configuring a Gigabit Ethernet Policer on page 465</a></li> <li>• <a href="#">input-policer on page 997</a></li> <li>• <a href="#">input-three-color on page 999</a></li> <li>• <a href="#">layer2-policer on page 1020</a></li> <li>• <a href="#">logical-interface-policer on page 1040</a></li> <li>• <a href="#">output-three-color on page 1103</a></li> </ul> |

## output-priority-map

---

|                                 |                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>output-priority-map {<br/>  classifier {<br/>    premium {<br/>      forwarding-class <i>class-name</i> {<br/>        loss-priority (high   low);<br/>      }<br/>    }<br/>  }<br/>}</pre>                                                               |
| <b>Hierarchy Level</b>          | <p>[edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile ethernet-policer-profile</a>]</p> <p>[edit interfaces <i>interface-name</i> ether-options <a href="#">ethernet-switch-profile ethernet-policer-profile</a>]</p> |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 13.2 for the QFX Series.</p>                                                                                                                              |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the output policer priority map to be applied to outgoing frames on this interface.</p> <p>The statements are explained separately.</p>                                             |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying an Output Priority Map on page 465</a></li><li>• <a href="#">input-priority-map on page 998</a></li></ul>                                                                                       |

## output-three-color

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>output-three-color <i>policer-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">layer2-policer</a> ]                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | Apply a single-rate or two-rate three-color policer to the Layer 2 output traffic at the logical interface. The <b>output-three-color</b> and <b>output-policer</b> statements are mutually exclusive.                                                                                                                                                                                                                                                                                                                                                          |
| <b>Options</b>                  | <i>policer-name</i> —Name of the single-rate or two-rate three-color policer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Two-Color and Three-Color Policers at Layer 2</i></li> <li>• <i>Applying Layer 2 Policers to Gigabit Ethernet Interfaces</i></li> <li>• <a href="#">Configuring a Gigabit Ethernet Policer on page 465</a></li> <li>• <a href="#">input-three-color on page 999</a></li> <li>• <a href="#">input-policer on page 997</a></li> <li>• <a href="#">layer2-policer on page 1020</a></li> <li>• <a href="#">logical-interface-policer on page 1040</a></li> <li>• <a href="#">output-policer on page 1101</a></li> </ul> |

## output-vlan-map (Aggregated Ethernet)

---

|                                 |                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>output-vlan-map {<br/>    (pop   push   swap);<br/>    tag-protocol-id <i>tpid</i>;<br/>    vlan-id <i>number</i>;<br/>}</pre>                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ]                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>For aggregated Ethernet interfaces using Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, and 100-Gigabit Ethernet Type 5 PIC with CFP only, define the rewrite profile to be applied to outgoing frames on this logical interface.</p> <p>The statements are explained separately.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 484</a></li><li>• <a href="#">input-vlan-map (Aggregated Ethernet) on page 1000</a></li></ul>                                                                                                  |

## output-vlan-map (Gigabit Ethernet IQ and 10-Gigabit Ethernet with SFPP)

|                                 |                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>output-vlan-map {   (pop   pop-pop   pop-swap   push   push-push   swap   swap-push   swap-swap);   inner-tag-protocol-id <i>tpid</i>;   inner-vlan-id <i>number</i>;   tag-protocol-id <i>tpid</i>;   vlan-id <i>number</i>; }</pre> |
| <b>Hierarchy Level</b>          | <pre>[edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i>]</pre>                       |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p><b>pop-pop</b>, <b>pop-swap</b>, <b>push-push</b>, <b>swap-push</b>, and <b>swap-swap</b> statements added in Junos OS Release 8.1.</p>                                        |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Port 10-Gigabit Ethernet SFPP interfaces only, define the rewrite operation to be applied to outgoing frames on this logical interface.</p> <p>The statements are explained separately.</p>              |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 484</a></li> <li>• <a href="#">input-vlan-map on page 1001</a></li> </ul>                                                   |

## pado-advertise

---

|                            |                                                                                                                                                                                                                 |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | pado-advertise;                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>     | [edit protocols pppoe]                                                                                                                                                                                          |
| <b>Release Information</b> | Statement introduced in Junos OS Release 10.2.                                                                                                                                                                  |
| <b>Description</b>         | Enable named services configured in PPPoE service name tables to be advertised in PPPoE Active Discovery Offer (PADO) control packets. By default, advertisement of named services in PADO packets is disabled. |



**NOTE:** If you enable advertisement of named services in PADO packets, make sure the number and length of all advertised service entries does not exceed the maximum transmission unit (MTU) size of the PPPoE underlying interface.

---

|                                 |                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring PPPoE Service Name Tables</i></li><li>• <i>Enabling Advertisement of Named Services in PADO Control Packets</i></li></ul> |

## pass-through

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (pass-through   no-pass-through);                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> <i>rate</i> ]                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                     |
| <b>Description</b>              | Enable or disable OTN pass-through mode.                                                                                                                                                                          |
| <b>Default</b>                  | By default, OTN pass-through mode is disabled.                                                                                                                                                                    |
| <b>Options</b>                  | <b>no-pass-through</b> —Do not enable OTN pass-through mode.<br><b>pass-through</b> —Enable OTN pass-through mode.                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |

## passive-monitor-mode

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>passive-monitor-mode;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i>],</code><br><code>[edit interfaces <i>interface-name</i> <i>unit</i> <i>logical-unit-number</i>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <i>unit</i> <i>logical-unit-number</i>]</code>                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Monitor packet flows from another router. If you include this statement in the configuration, the interface does not send keepalives or alarms, and does not participate actively on the network.</p> <p>This statement is supported on ATM, Ethernet, and SONET/SDH interfaces. For more information, see <i>ATM Interfaces Feature Guide for Routing Devices</i>.</p> <p>For ATM and Ethernet interfaces, you can include this statement on the physical interface only.</p> <p>For SONET/SDH interfaces, you can include this statement on the logical interface only.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Enabling Passive Monitoring on ATM Interfaces</i></li> <li>• <a href="#">Passive Monitoring on Ethernet Interfaces Overview on page 29</a></li> <li>• <i>Enabling Packet Flow Monitoring on SONET/SDH Interfaces</i></li> <li>• <i>multiservice-options</i></li> <li>• <i>Junos OS Services Interfaces Library for Routing Devices</i></li> </ul>                                                                                                                                                                                    |

## path-database-size

---

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>path-database-size <i>path-database-size</i>;</code>                                                              |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management linktrace</a> ]                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                           |
| <b>Description</b>              | Number of linktrace reply entries to be stored per linktrace request.                                                   |
| <b>Options</b>                  | <b>path-database-size</b> —Database size.<br><b>Range:</b> 1 through 255<br><b>Default:</b> 64                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Linktrace Protocol in CFM on page 539</a></li></ul>     |

## pdu-interval

---

|                                 |                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>pdu-interval <i>interval</i>;</code>                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management interface <i>interface-name</i></a> ]                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                    |
| <b>Description</b>              | For Ethernet interfaces on EX Series switches and M320, M120, MX Series, and T Series routers, specify the periodic OAM PDU sending interval for fault detection. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support. |
| <b>Options</b>                  | <b><i>interval</i></b> —Periodic OAM PDU sending interval.<br><b>Range:</b> 100 through 1000 milliseconds<br><b>Default:</b> 1000 milliseconds                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring the OAM PDU Interval on page 599</a></li></ul>                                                                                                                                   |



## pdu-threshold

|                                 |                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>pdu-threshold <i>threshold-value</i>;</code>                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet link-fault-management interface</a> <i>interface-name</i> ]                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                   |
| <b>Description</b>              | For Ethernet interfaces on EX Series switches and M320, M120, MX Series, and T Series routers, specify the number of OAM PDUs to miss before an error is logged. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support. |
| <b>Options</b>                  | <p><b><i>threshold-value</i></b>—The number of PDUs missed before declaring the peer lost.</p> <p><b>Range:</b> 3 through 10 PDUs</p> <p><b>Default:</b> 3 PDUs</p>                                                                             |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the OAM PDU Threshold on page 600</a></li> </ul>                                                                                                                               |

## per-flow (Aggregated Ethernet Interfaces)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>per-flow;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit interfaces <i>aeX unit logical-unit-number</i> forwarding-options load-balance-stateful]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | Enable the mechanism to perform an even, effective distribution of traffic flows across member links of an aggregated Ethernet interface ( <b>ae</b> ) bundle on MX Series routers with MPCs, except MPC3Es and MPC4Es. When multiple flows are transmitted out of an <b>ae</b> interface, the flows must be distributed across the different member links evenly to enable an effective and optimal load-balancing behavior. To obtain a streamlined and robust method of load-balancing, the member link of the aggregated Ethernet interface bundle that is selected each time for load balancing plays a significant part. |
| <b>Options</b>                  | <b><i>per-flow</i></b> —Enable the stateful load-distribution mechanism per traffic flow on an aggregated Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## peer

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>peer a.b.c.d {<br/>    interface <i>interface-name</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> <b>multi-chassis-protection</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Release Information      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description              | For MX Series routers with multichassis aggregated Ethernet (MC-AE) interfaces, use the <b>multi-chassis-protection</b> statement under the physical interface level to reduce the configuration at the logical interface level. If the interchassis control protocol connection (ICCP) is UP and the interchassis data link (ICL) comes UP, the router configured as standby will bring up the MC-AE interfaces shared with the peer active-active node specified by the <b>peer</b> statement. You must also specify the peer's physical interface. |
| Options                  | <p><b>a.b.c.d</b>—Specify the IP address of the peer.</p> <p><b>interface <i>interface-name</i></b>—Specify the peer's physical interface: interface <i>interface-name-fpc/pic/port</i></p>                                                                                                                                                                                                                                                                                                                                                           |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Multichassis Link Aggregation on MX Series Routers</a></li><li>• <a href="#">Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation</a></li><li>• <a href="#">Configuring Aggregated Ethernet Link Protection on page 156</a></li><li>• <a href="#">Example: Configuring Aggregated Ethernet Link Protection on page 158</a></li><li>• <a href="#">multi-chassis-protection on page 1075</a></li></ul>                                                 |

## performance-monitoring

```
Syntax performance-monitoring {
    delegate-server-processing;
    hardware-assisted-timestamping;
    hardware-assisted-keepalives;
    sla-iterator-profiles {
        profile-name {
            avg-fd-twoway-threshold;
            avg-ifdv-twoway-threshold;
            avg-flr-forward-threshold;
            avg-flr-backward-threshold;
            disable;
            calculation-weight {
                delay delay-weight;
                delay-variation delay-variation-weight;
            }
            cycle-time milliseconds;
            iteration-period connections;
            measurement-type (loss | statistical-frame-loss | two-way-delay);
        }
    }
}
```

**Hierarchy Level** [edit protocols [oam](#) [ethernet](#) [connectivity-fault-management](#)]

**Release Information** Statement introduced in Junos OS Release 9.5.

**Description** Specify performance monitoring support for Ethernet frame delay measurement.

The remaining statements are explained separately.

**Required Privilege Level** Configure—To enter configuration mode.  
Control—To modify any configuration.

**Related Documentation**

- [Ethernet Frame Delay Measurements Overview on page 622](#)
- [Guidelines for Configuring Routers to Support an ETH-DM Session on page 664](#)
- [Enabling the Hardware-Assisted Timestamping Option on page 674](#)

## periodic

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>periodic interval;</code>                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces aex <a href="#">aggregated-ether-options lacp</a> ],<br>[edit interfaces interface-range <i>name</i> <a href="#">aggregated-ether-options lacp</a> ]                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                              |
| <b>Description</b>              | For aggregated Ethernet interfaces only, configure the interval for periodic transmission of LACP packets.                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <i>interval</i> —Interval for periodic transmission of LACP packets. <ul style="list-style-type: none"><li>• <b>fast</b>—Transmit packets every second.</li><li>• <b>slow</b>—Transmit packets every 30 seconds.</li></ul> <b>Default:</b> <b>fast</b>                                                                                                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LACP for Aggregated Ethernet Interfaces on page 148</a></li><li>• <i>Configuring Aggregated Ethernet LACP (CLI Procedure)</i></li><li>• <i>Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch</i></li></ul> |

---

## policer (CFM Firewall)

---

|                                 |                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>policer <i>cfm-policer</i> {<br/>    if-exceeding {<br/>        bandwidth-limit 8k;<br/>        burst-size-limit 2k;<br/>    }<br/>    then discard;<br/>}</pre>                                                                                     |
| <b>Hierarchy Level</b>          | [edit firewall]                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                            |
| <b>Description</b>              | Attach an explicit policer to CFM sessions.                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Rate Limiting of Ethernet OAM Messages on page 566</a></li><li>• <a href="#">policer (CFM Global) on page 1114</a></li><li>• <a href="#">policer (CFM Session) on page 1115</a></li></ul> |

## policer (CFM Global)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>policer {<br/>    all <i>cfm-policer-name</i>;<br/>    continuity-check <i>cfm-policer-name</i>;<br/>    other <i>cfm-policer-name</i>;<br/>}</pre>                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management]                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | Specify a policer at the global level to police the CFM traffic belonging to all sessions.                                                                                                                                                                                                                                                                                                                   |
| <b>Options</b>                  | <p><b>continuity-check <i>cfm-policer-name</i></b>—Police all continuity check packets with the policer specified.</p> <p><b>other <i>cfm-policer-name</i></b>—Police all non-continuity check packets with the policer specified.</p> <p><b>all <i>cfm-policer-name</i></b>—Police all CFM packets with policer specified. If the <b>all</b> option is used, then you cannot specify above two options.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Rate Limiting of Ethernet OAM Messages on page 566</a></li><li>• <a href="#">policer (CFM Session) on page 1115</a></li></ul>                                                                                                                                                                                                                |

## policer (CFM Session)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> policer {     all <i>cfm-policer-name</i>;     continuity-check <i>cfm-policer-name</i>;     other <i>cfm-policer-name</i>; } </pre>                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>name</i> level <i>number</i> maintenance-association <i>name</i> ]                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Specify a separate policer to rate-limit packets specific to that session.                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Options</b>                  | <ul style="list-style-type: none"> <li>• <b>continuity-check <i>cfm-policer-name</i></b>—Police continuity check packets belonging to this session.</li> <li>• <b>other <i>cfm-policer-name</i></b>—Police all non-continuity check packets belonging to this session.</li> <li>• <b>all <i>cfm-policer-name</i></b>—Police all CFM packets belonging to this session. If the <b>all</b> option is used, then you cannot specify the above two options.</li> </ul> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Rate Limiting of Ethernet OAM Messages on page 566</a></li> <li>• <a href="#">policer (CFM Global) on page 1114</a></li> </ul>                                                                                                                                                                                                                                                                    |


## policer (CoS)

---


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>policer <i>cos-policer-name</i> {<br/>    aggregate {<br/>        bandwidth-limit <i>bps</i>;<br/>        burst-size-limit <i>bytes</i>;<br/>    }<br/>    premium {<br/>        bandwidth-limit <i>bps</i>;<br/>        burst-size-limit <i>bytes</i>;<br/>    }<br/>}</pre>                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | For Gigabit Ethernet IQ, Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), and 100-Gigabit Ethernet Type 5 PIC with CFP, define a CoS policer template to specify the premium bandwidth and burst-size limits, and the aggregate bandwidth and burst-size limits. The premium policer is not supported on MX Series routers or for Gigabit Ethernet interfaces with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router). |
| <b>Options</b>                  | <p><b><i>cos-policer-name</i></b>—Name of one policer to specify the premium bandwidth and burst-size limits, and the aggregate bandwidth and burst-size limits.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                            |



## policer (MAC)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <pre> policer {     input <i>cos-policer-name</i>;     output <i>cos-policer-name</i>; } </pre>                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>[edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>accept-source-mac</b> <i>mac-address</i> <i>mac-address</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>accept-source-mac</b> <i>mac-address</i> <i>mac-address</i>]</p> |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.</p>                                                                                                                                                                                                               |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), and 100-Gigabit Ethernet Type 5 PIC with CFP, configure MAC policing.</p>                                                                                                          |
| <div>  <p><b>NOTE:</b></p> <p>On MX Series routers with Gigabit Ethernet or Fast Ethernet PICs, the following considerations apply:</p> <ul style="list-style-type: none"> <li>Interface counters do not count the 7-byte preamble and 1-byte frame delimiter in Ethernet frames.</li> <li>In MAC statistics, the frame size includes MAC header and CRC before any VLAN rewrite/imposition rules are applied.</li> <li>In traffic statistics, the frame size encompasses the L2 header without CRC after any VLAN rewrite/imposition rule.</li> </ul> </div> |                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p><b>input <i>cos-policer-name</i></b>—Name of one policer to specify the premium bandwidth and aggregate bandwidth.</p> <p><b>output <i>cos-policer-name</i></b>—Name of one policer to specify the premium bandwidth and aggregate bandwidth.</p>                                                                                                  |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                    |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li><a href="#">Configuring MAC Address Filtering on page 465</a></li> </ul>                                                                                                                                                                                                                                       |

## pop

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | pop;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ]                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p> <b>NOTE:</b> On EX4300 switches, <b>pop</b> is not supported at the [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>] hierarchy level.</p> <p>For Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2, and IQ2-E interfaces; 10-Gigabit Ethernet LAN/WAN PIC; aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces; 100-Gigabit Ethernet Type 5 PIC with CFP; and Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces, specify the VLAN rewrite operation to remove a VLAN tag from the top of the VLAN tag stack. The outer VLAN tag of the frame is removed.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Removing a VLAN Tag on page 494</a></li> <li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## pop-pop

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | pop-pop;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP, and for 10-Gigabit Ethernet SFP interfaces on EX Series switches, specify the VLAN rewrite operation to remove both the outer and inner VLAN tags of the frame.                                                                                                         |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Removing the Outer and Inner VLAN Tags on page 495</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                              |

## pop-swap

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | pop-swap;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>Specify the VLAN rewrite operation to remove the outer VLAN tag of the frame, and replace the inner VLAN tag of the frame with a user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.</p> <p>You can use this statement on Gigabit Ethernet IQ, IQ2, IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP.</p>             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag on page 496</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                          |

## port-description-type

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | port-description-type {<br>interface-alias;<br>interface-description;<br>}                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>     | [edit protocols lldp]<br>[edit routing- instances <i>routing-instance-name</i> protocols lldp]                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b> | Statement introduced in Junos OS Release 13.3R5, 14.2R2, 14.1R4, and 12.3R9.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>         | For Link Layer Discovery Protocol, configure the value to be used for port description TLV.                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>             | <p><b>interface-alias</b>—Use the <i>ifAlias</i> MIB object value to generate the port description TLV.</p> <p><b>interface-description</b>—Use the <i>ifDescr</i> MIB object value to generate the port description TLV.</p> <p><b>Default:</b> By default, <b>interface-alias</b> is used for generation of port description TLV. The <b>interface-alias</b> value is same as description of an interface configured by statement <b>set interface <i>name</i> description <i>description</i></b>.</p> |



**NOTE:** The LLDP MIB *lldpLocPortDesc* value gets changed depending on the setting of **port-description-type** statement. That is:

- If you configure the **port-description-type interface-alias** statement, the MIB variable *lldpLocPortDesc* displays the value same as that of MIB variable *ifAlias*, which is same as the description of the interface. By default, the MIB variable *lldpLocPortDesc* displays the value same as that of MIB variable *ifAlias*.
- If you configure the **port-description-type interface-description** statement, the MIB variable *lldpLocPortDesc* displays the value of MIB variable *ifDescr*, which is same as that of interface name.

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|

|                              |                                                                                                                                                                                                     |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"> <li>• <a href="#">lldp on page 1032</a></li> <li>• <a href="#">show lldp on page 1699</a></li> <li>• <a href="#">show lldp neighbors on page 1705</a></li> </ul> |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## port-id (MACsec for MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>port-id <i>port-id-number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | <code>[edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> id]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | <p>Specify a port ID in a secure channel when enabling MACsec using static secure association key (SAK) security mode. The port IDs must match on a sending and receiving secure channel on each side of a link to enable MACsec.</p> <p>Once the port numbers match, MACsec is enabled for all traffic on the connection.</p> <p>You only use this configuration option when you are configuring MACsec using static SAK security mode. This option does not need to be specified when you are enabling MACsec using static connectivity association key (CAK) security mode.</p> |
| <b>Default</b>                  | No port ID is specified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | <i>port-id-number</i> —The port ID number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                               |

## port-priority

---

|                                 |                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>port-priority <i>priority</i>;</code>                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <i>gigether-options</i> <a href="#">802.3ad</a> lacp]                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                                                                             |
| <b>Description</b>              | Define LACP port priority at the interface level.                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b><i>priority</i></b>—Priority for being elected to be the active port and both collect and distribute traffic. A smaller value indicates a higher priority for being elected.</p> <p><b>Range:</b> 0 through 65535</p> <p><b>Default:</b></p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</i></li> <li>• <i>Configuring Aggregated Ethernet LACP</i></li> </ul>                                               |

## port-id-subtype

|                            |                                                                                                                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | port-id-subtype {<br>interface-name;<br>locally-assigned;<br>}                                                                                                                                                          |
| <b>Hierarchy Level</b>     | [edit protocols lldp]<br>[edit routing- instances <i>routing-instance-name</i> protocols lldp]                                                                                                                          |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.3R1                                                                                                                                                                         |
| <b>Description</b>         | For Link Layer Discovery Protocol, configure the port ID type, length, and value (TLV).                                                                                                                                 |
| <b>Options</b>             | <b>interface-name</b> —Use the interface name to generate the port ID TLV.<br><b>Default:</b> Use the SNMP index of the interface to generate the port ID TLV. This is the default option used to generate port ID TLV. |



**NOTE:** The `show lldp neighbors` command displays the content of the port ID TLV received from the peer in the **port Info** field. Changing the configuration of **port-id-subtype** affects the display of the `show lldp neighbors` command on the peer device running Junos OS.

When the value of **port-id-subtype** is set to **locally-assigned**, which is the default value, the `show lldp neighbors` command on the peer device running Junos OS displays the SNMP index as the port information for the local device.

When the value of **port-id-subtype** is set to **interface-name**, the `show lldp neighbors` command on the peer device running Junos OS displays the interface name as the port information for the local device.

The value of the MIB variable `lldpLocPortId` depends on the SNMP MIB object entity that is used to generate the port ID TLV. If the port ID TLV generation is configured to use the interface name in the `set port-id-subtype interface-name` command, then the value of the MIB variable `lldpLocPortId` is the interface name and not the SNMP index.

|                                 |                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">lldp on page 1032</a></li> <li>• <a href="#">Configuring LLDP on page 316</a></li> <li>• <a href="#">show lldp neighbors on page 1705</a></li> </ul> |



---

## port-status-tlv

---

|                                 |                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>port-status-tlv blocked;</code>                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet</a> connectivity-fault-management <a href="#">action-profile</a> <i>tlv-action</i> event]                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                                                                |
| <b>Description</b>              | Define an <b>action-profile</b> consisting of various events and the action. Based on values of <b>port-status-tlv</b> in the received CCM packets, specific action such as <i>interface-down</i> can be taken using <a href="#">action-profile</a> options. |
| <b>Options</b>                  | <b>blocked</b> —When the incoming CCM packet contains port status TLV with value blocked, the action will be triggered for this action-profile.                                                                                                              |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 538</a></li><li>• <a href="#">Configuring Remote MEP Action Profile Support on page 548</a></li></ul>                     |

## pp0 (Dynamic PPPoE)

```
Syntax  pp0 {
        unit logical-unit-number {
            keepalives interval seconds;
            no-keepalives;
            pppoe-options {
                underlying-interface interface-name;
                server;
            }
            ppp-options {
                authentication [ authentication-protocols ];
                chap {
                    challenge-length minimum minimum-length maximum maximum-length;
                }
                pap;
            }
            family inet {
                unnumbered-address interface-name;
                address address;
                service {
                    input {
                        service-set service-set-name {
                            service-filter filter-name;
                        }
                        post-service-filter filter-name;
                    }
                    output {
                        service-set service-set-name {
                            service-filter filter-name;
                        }
                    }
                }
                filter {
                    input filter-name {
                        precedence precedence;
                    }
                    output filter-name {
                        precedence precedence;
                    }
                }
            }
        }
    }
```

**Hierarchy Level** [edit dynamic-profiles *profile-name* interfaces]

**Release Information** Statement introduced in Junos OS Release 10.1.

**Description** Configure the dynamic PPPoE logical interface in a dynamic profile. When the router creates a dynamic PPPoE logical interface on an underlying Ethernet interface configured with PPPoE (**ppp-over-ether**) encapsulation, it uses the information in the dynamic profile to determine the properties of the dynamic PPPoE logical interface.

The remaining statements are explained separately.

|                                 |                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring a PPPoE Dynamic Profile</i></li> <li>• <i>Configuring Dynamic Authentication for PPP Subscribers</i></li> <li>• For information about creating static PPPoE interfaces, see <a href="#">Configuring PPPoE on page 331</a></li> </ul> |

## ppm (Ethernet Switching)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>ppm {     centralized; }</pre>                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols lacp]                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 9.4 for MX Series routers.</p> <p>Statement introduced in Junos OS Release 10.2 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.3 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 12.1 for T Series devices.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>                                                    |
| <b>Description</b>              | <p>Configure PPM processing options for Link Aggregation Control Protocol (LACP) packets.</p> <p>This command configures the PPM processing options for LACP packets only. You can disable distributed PPM processing for all packets that use PPM and run all PPM processing on the Routing Engine by configuring the <b>no-delegate-processing</b> configuration statement in the <b>[edit routing-options ppm]</b> statement hierarchy.</p> |
| <b>Default</b>                  | Distributed PPM processing is enabled for all packets that use PPM.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)</i></li> <li>• <a href="#">Configuring Distributed Periodic Packet Management on page 202</a></li> </ul>                                                                                                                                                                                                 |

## pppoe-options

---

|                                 |                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>pppoe-options {<br/>    access-concentrator name;<br/>    auto-reconnect seconds;<br/>    (client   server);<br/>    service-name name;<br/>    underlying-interface interface-name;<br/>}</pre> |
| <b>Hierarchy Level</b>          | [edit interfaces pp0 unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces pp0 unit <i>logical-unit-number</i> ]                                          |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br><b>client</b> Statement introduced in Junos OS Release 8.5.<br><b>server</b> Statement introduced in Junos OS Release 8.5.                       |
| <b>Description</b>              | Configure PPP over Ethernet-specific interface properties.<br><br>The remaining statements are explained separately.                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring a PPPoE Interface on page 331</a></li></ul>                                                                                           |

## pppoe-underlying-options (Static and Dynamic Subscribers)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>pppoe-underlying-options {   access-concentrator <i>name</i>;   dynamic-profile <i>profile-name</i>;   direct-connect   duplicate-protection;   max-sessions <i>number</i>;   max-sessions-vsa-ignore;   service-name-table <i>table-name</i>;   short-cycle-protection &lt;lockout-time-min <i>minimum-seconds</i>&gt; &lt;lockout-time-max     <i>maximum-seconds</i>&gt; &lt;filter [<i>aci</i>]&gt;; }</pre> |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> ]                                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p>Configure PPPoE-specific interface properties for the underlying interface on which the router creates a static or dynamic PPPoE logical interface. The underlying interface must be configured with PPPoE (<b>ppp-over-ether</b>) encapsulation.</p> <p>The remaining statements are explained separately.</p>                                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring PPPoE on page 331</a> (for static interfaces)</li> <li>• <i>Configuring an Underlying Interface for Dynamic PPPoE Subscriber Interfaces</i></li> <li>• <i>Assigning a Service Name Table to a PPPoE Underlying Interface</i></li> </ul>                                                                                                              |

## pre-shared-key (MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>pre-shared-key {<br/>    cak hexadecimal-number;<br/>    ckn hexadecimal-number;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | <p>Specifies the pre-shared key used to enable MACsec using static connectivity association key (CAK) security mode.</p> <p>A pre-shared key includes a connectivity association key name (CKN) and a connectivity association key (CAK). A pre-shared key is exchanged between two devices at each end of a point-to-point link to enable MACsec using static CAK security mode. The MACsec Key Agreement (MKA) protocol is enabled after the pre-shared keys are successfully verified and exchanged. The pre-shared key—the CKN and CAK—must match on both ends of a link.</p> |
| <b>Default</b>                  | No pre-shared keys exist, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                              |

## premium (Output Priority Map)

|                                 |                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>premium {   forwarding-class <i>class-name</i> {     loss-priority (high   low);   } }</pre>                                                                                                         |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">output-priority-map</a> <a href="#">classifier</a> ] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                         |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ interfaces only, define the classifier for egress premium traffic.</p> <p>The statements are explained separately.</p>                                                         |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying an Output Priority Map on page 465</a></li> <li>• <a href="#">input-priority-map on page 998</a></li> </ul>                               |

## premium (Policer)

|                                 |                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>premium {   bandwidth-limit <i>bps</i>;   burst-size-limit <i>bytes</i>; }</pre>                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">policer</a> <i>cos-policer-name</i> ]                                                              |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Define a policer to apply to nonpremium traffic.</p> <p>The statements are explained separately.</p>                                                                                                                                                 |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li> <li>• <a href="#">aggregate (Gigabit Ethernet CoS Policer) on page 870</a></li> <li>• <a href="#">ieee802.1p on page 989</a></li> </ul> |

## priority (Protocols OAM)

---

|                          |                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <code>priority <i>priority-value</i>;</code>                                                                                                                                                                                                                                                                                                       |
| Hierarchy Level          | [edit protocols <a href="#">oam</a> <a href="#">ethernet connectivity-fault-management maintenance-domain</a> <a href="#">md-name maintenance-association</a> <a href="#">ma-name mep</a> <a href="#">mep-id remote-mep</a> <a href="#">remote-mep-id sla-iterator-profile</a> <a href="#">profile-name</a> <a href="#">sla-iterator-profile</a> ] |
| Release Information      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                     |
| Description              | Configure the priority of the iterator profile, which is the <b>vlan-pcp</b> value that is sent in the Y.1731 data frames.                                                                                                                                                                                                                         |
| Options                  | <b>priority-value</b> —Priority value, which is the <b>vlan-pcp</b> value that is sent in the Y.1731 data frames.<br><b>Range:</b> 0 through 7<br><b>Default:</b> 0                                                                                                                                                                                |
| Required Privilege Level | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                                                                     |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">sla-iterator-profile on page 1184</a></li><li>• <a href="#">Configuring a Remote MEP with an Iterator Profile on page 662</a></li></ul>                                                                                                                                                        |

## priority (CFM MEP)

---

|                          |                                                                                                                                                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <code>priority <i>value</i>;</code>                                                                                                                                                                               |
| Hierarchy Level          | [edit protocols <a href="#">oam</a> <a href="#">ethernet connectivity-fault-management action-profile</a> <a href="#">action-profile-name</a> <a href="#">action log-generate-ais</a> ]                           |
| Release Information      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                    |
| Description              | Configure the 802.1p priority of the AIS packet.                                                                                                                                                                  |
| Options                  | <b>value</b> —Priority level.<br><b>Range:</b> 0 through 7                                                                                                                                                        |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul> |



## priority (OAM Connectivity-Fault Management)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>priority <i>number</i>;</code>                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | <p>[edit protocols <a href="#">oam ethernet connectivity-fault-management maintenance-domain</a> <i>md-name</i> <a href="#">maintenance-association</a> <i>ma-name</i> <a href="#">mep</a> <i>mep-id</i>]</p> <p>For EX Series Switches:</p> <p>[edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> mep <i>mep-id</i>]</p> |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | IEEE 802.1p priority bits used by the continuity check messages.                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <p><b><i>number</i></b>—Configure the IEEE 802.1p priority bits to be used in the VLAN header of the CFM packets.</p> <p><b>Range:</b> 0 through 7</p>                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> </ul>                                                                                                                                                                                                                                                             |

## propagate-tc

|                                 |                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>propagate-tc;</code>                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring</a> <i>ring-name</i> ]                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                        |
| <b>Description</b>              | <p>Enable topology change propagation from a sub-ring to an interconnected major-ring. By default, topology change propagation is disabled.</p>                                                                       |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul> |

## protection-group

```
Syntax  protection-group {
        ethernet-ring ring-name {
            data-channel {
                vlan number
            }
            east-interface {
                control-channel channel-name {
                    vlan number;
                    interface name interface-name
                }
            }
            guard-interval number;
            node-id mac-address;
            restore-interval number;
            ring-protection-link-owner;
            non-revertive;
            wait-to-block-interval number;
            major-ring-name name;
            propagate-tc;
            compatibility-version (1|2);
            ring-id number;
            non-vc-mode;
            dot1p-priority number;
            west-interface {
                control-channel channel-name {
                    vlan number;
                    interface name interface-name
                }
                virtual-control-channel {
                    west-interface name;
                    east-interface name;
                }
            }
        }
    }
    control-vlan (vlan-id | vlan-name);
    east-interface {
        node-id mac-address;
        control-channel channel-name {
            vlan number;
            interface name interface-name
        }
        interface-none
        ring-protection-link-end;
    }
}
control-channel channel-name {
    vlan number;
    interface name interface-name
}
}
data-channel {
    vlan number
```

```


}
guard-interval number;
node-id mac-address;
restore-interval number;
ring-protection-link-owner;
west-interface {
    node-id mac-address;
    control-channel channel-name {
        vlan number;
        interface name interface-name
    }
    interface-none
    ring-protection-link-end;
}
control-channel channel-name {
    vlan number;
    interface name interface-name
}
}
}
guard-interval number;
restore-interval number;
tracoptions {
    file filename <no-stamp> <world-readable | no-world-readable> <replace> <size size>;
    flag flag;
}
}

```

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hierarchy Level          | [edit protocols]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Release Information      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description              | Configure Ethernet ring protection switching.<br><br>The statements are explained separately. All statements apply to MX Series routers. EX Series switches do not assign <b>node-id</b> and use <b>control-vlan</b> instead of <b>control-channel</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Related Documentation    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739</a></li> <li>• <a href="#">Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 746</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</a></li> <li>• <a href="#">Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul> |

## protocols

---

|                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                   | <code>protocols [inet iso mpls];</code>                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                          | [edit interfaces <i>interface-name</i> <b>unit</b> logical-unit-number <b>family</b> tcc]                                                                                                                                                                                                                                                       |
| <b>Release Information</b>                                                                                                                                                                                                                                                      | Statement introduced in Junos OS Release 8.3.                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>                                                                                                                                                                                                                                                              | For Layer 2.5 VPNs on T Series, MX Series, M120, and M320 routers support, configure IS-IS (ISO traffic) or MPLS traffic to traverse a TCC interface. By default, IPv4 (inet) traffic runs on T Series, MX, Series, M120, and M320 routers and over TCC interfaces. You must configure the same traffic type on both ends of the Layer 2.5 VPN. |
| <div> <b>NOTE:</b> Some platform and FPC combinations can not pass TCC encapsulated ISO traffic. See <i>Platforms/FPCs That Cannot Forward TCC Encapsulated ISO Traffic</i> for details.</div> |                                                                                                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                 | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                         |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"><li>• <i>Configuring IS-IS or MPLS Traffic for TCC Interfaces</i></li><li>• <i>Platforms/FPCs That Cannot Forward TCC Encapsulated ISO Traffic</i></li></ul>                                                                                                                                                  |

## protocol (Server MEP)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>protocol (l2circuit   l2vpn   ethernet) {<br/>    interface <i>interface-name</i>;<br/>}</code>                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management]                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Configure the protocol as Layer 2 circuit, Layer 2 VPN, or Ethernet and associate the interface to the protocol that needs to be monitored for ETH-AIS.                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b>l2circuit</b>—Configure the protocol for the server MEP as Layer 2 circuit.</p> <p><b>l2vpn</b>—Configure the protocol for the server MEP as Layer 2 VPN.</p> <p><b>ethernet</b>—Configure the protocol for the server MEP as Ethernet.</p> <p><b>interface <i>interface-name</i></b>—The interface that is to be associated with the protocol that needs monitoring for ETH-AIS.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li> <li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li> </ul>                                                                                                                                                                        |

## protocol-down

|                                 |                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>protocol-down;</code>                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event</a> ]                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                                |
| <b>Description</b>              | Upper layer indication of protocol down event. When the <b>protocol-down</b> statement is included, the protocol down event triggers the action specified under the <b>action</b> statement. |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an OAM Action Profile on page 603</a></li> </ul>                                                                            |

## ptopo-configuration-maximum-hold-time

---


|                                 |                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>ptopo-configuration-maximum-hold-time <i>seconds</i>;</code>                                                                      |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ]        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                           |
| <b>Description</b>              | Configure a time to maintain dynamic topology entries.                                                                                  |
| <b>Options</b>                  | <b><i>seconds</i></b> —Time to maintain interval dynamic topology entries.<br><b>Default:</b> 300<br><b>Range:</b> 1 through 2147483647 |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                          |

## ptopo-configuration-trap-interval

---

|                                 |                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>ptopo-configuration-trap-interval <i>seconds</i>;</code>                                                                                                      |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ]                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                                                       |
| <b>Description</b>              | Configure a time for the period of SNMP trap notifications to the Master Agent to wait regarding changes in topology global statistics.                             |
| <b>Options</b>                  | <b><i>seconds</i></b> —Time for the period of SNMP trap notifications about global statistics. This feature is disabled by default.<br><b>Range:</b> 0 through 3600 |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                                                      |

## push

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>push;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</code><br><code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | <p> <b>NOTE:</b> On EX4300 switches, <code>push</code> is not supported at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code> hierarchy level.</p> <p>Specify the VLAN rewrite operation to add a new VLAN tag to the top of the VLAN stack. An outer VLAN tag is pushed in front of the existing VLAN tag.</p> <p>You can use this statement on Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces; 10-Gigabit Ethernet LAN/WAN PIC; aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces; 100-Gigabit Ethernet Type 5 PIC with CFP; and Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces.</p> <p>If you include the <b>push</b> statement in the configuration, you must also include the <a href="#">pop</a> statement at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code> hierarchy level.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Stacking a VLAN Tag on page 493</a></li> <li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## push-push

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | push-push;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>Specify the VLAN rewrite operation to push two VLAN tags in front of the frame.</p> <p>You can use this statement on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP.</p>                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Stacking Two VLAN Tags on page 494</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                |

## prbs

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (prbs   no-prbs);                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                             |
| <b>Description</b>              | Specify whether OTN payload Pseudo-Random Binary Sequence (PBRs) is enabled or disabled.                                                                                                                          |
| <b>Default</b>                  | By default, OTN payload prbs is disabled.                                                                                                                                                                         |
| <b>Options</b>                  | <b>prbs</b> —Enable OTN payload PBRs.<br><b>no-prbs</b> —Disable OTN payload PBRs.                                                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |



## preemptive-fast-reroute

|                                 |                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>preemptive-fast-reroute {   (backward-frr-enable   no-backward-frr-enable);   (signal-degrade-monitor-enable   no-signal-degrade-monitor-enable);   (odu-backward-frr-enable   no-odu-backward-frr-enable); # applicable for P2-100GE-OTN   PIC only   (odu-signal-degrade-monitor-enable   no-odu-signal-degrade-monitor-enable);   #applicable for P2-100GE-OTN PIC only }</pre> |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.<br>Statement introduced in Junos OS Release 13.3 for MX Series routers.                                                                                                                                                                                                                                           |
| <b>Description</b>              | Enable or disable preemptive fast reroute options.                                                                                                                                                                                                                                                                                                                                      |
| <b>Default</b>                  | By default, backward fast reroute insertion and signal degradation monitoring are disabled.                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul>                                                                      |

## premium (Output Priority Map)

---

|                          |                                                                                                                                                                                                  |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>premium {<br/>    forwarding-class <i>class-name</i> {<br/>        loss-priority (high   low);<br/>    }<br/>}</pre>                                                                        |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">output-priority-map</a> <i>classifier</i> ] |
| Release Information      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                |
| Description              | <p>For Gigabit Ethernet IQ interfaces only, define the classifier for egress premium traffic.</p> <p>The statements are explained separately.</p>                                                |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                          |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Specifying an Output Priority Map on page 465</a></li><li>• <a href="#">input-priority-map on page 998</a></li></ul>                         |

## premium (Policer)

---

|                          |                                                                                                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <pre>premium {<br/>    bandwidth-limit <i>bps</i>;<br/>    burst-size-limit <i>bytes</i>;<br/>}</pre>                                                                                                                                               |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> gigether-options <a href="#">ethernet-switch-profile</a> <a href="#">ethernet-policer-profile</a> <a href="#">policer</a> <i>cos-policer-name</i> ]                                                          |
| Release Information      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                   |
| Description              | <p>Define a policer to apply to nonpremium traffic.</p> <p>The statements are explained separately.</p>                                                                                                                                             |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                             |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Gigabit Ethernet Policers on page 465</a></li><li>• <a href="#">aggregate (Gigabit Ethernet CoS Policer) on page 870</a></li><li>• <a href="#">ieee802.1p on page 989</a></li></ul> |


## protect-maintenance-association (OAM)

|                                 |                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>protect-maintenance-association <i>protect-ma-name</i>;</code>                                                                               |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management maintenance-domain <i>domain-name</i> maintenance-association <i>ma-name</i> ]          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.4                                                                                                      |
| <b>Description</b>              | Configure the name of the protect transport path for the maintenance-association.                                                                  |
| <b>Options</b>                  | <i>protect-ma-name</i> —The name of the protect transport path.                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> </ul> |


## proxy

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>proxy inet-address <i>address</i>;</code>                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">family</a> tcc],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">family</a> tcc]                                                                                                                               |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | For Layer 2.5 VPNs using an Ethernet interface as the TCC router, configure the IP address for which the TCC router is proxying. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only. Ethernet TCC is not supported on the T640 router. |
| <b>Options</b>                  | <i>inet-address</i> —Configure the IP address of the neighbor to the TCC router.                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Translation Cross-Connect Interface Switching on page 353</a></li> <li>• <a href="#">Example: Configuring an Ethernet TCC or Extended VLAN TCC on page 353</a></li> <li>• <a href="#">remote on page 1152</a></li> <li>• <i>Junos OS VPNs Library for Routing Devices</i></li> </ul>                                                              |

## proxy-arp

|                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                  | <code>proxy-arp (restricted   unrestricted);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>                                                                                                                                                                                         | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>                                                                                                                                                                                     | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.6 for EX Series switches.<br><b>restricted</b> added in Junos OS Release 10.0 for EX Series switches.<br>Statement introduced in Junos OS Release 12.2 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>                                                                                                                                                                                             | For Ethernet interfaces only, configure the router or switch to respond to any ARP request, as long as the router or switch has an active route to the ARP request's target address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <div>  <b>NOTE:</b> You must configure the IP address and the inet family for the interface when you enable proxy ARP. </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Default</b>                                                                                                                                                                                                 | Proxy ARP is not enabled. The router or switch responds to an ARP request only if the destination IP address is its own.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li><b>none</b>—The router or switch responds to any ARP request for a local or remote address if the router or switch has a route to the target IP address.</li> <li><b>restricted</b>—(Optional) The router or switch responds to ARP requests in which the physical networks of the source and target are different and does not respond if the source and target IP addresses are in the same subnet. The router or switch must also have a route to the target IP address.</li> <li><b>unrestricted</b>—(Optional) The router or switch responds to any ARP request for a local or remote address if the router or switch has a route to the target IP address.</li> </ul> |
|                                                                                                                                                                                                                | <b>Default:</b> <b>unrestricted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b>                                                                                                                                                                                | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>                                                                                                                                                                                   | <ul style="list-style-type: none"> <li><a href="#">Configuring Restricted and Unrestricted Proxy ARP on page 345</a></li> <li><a href="#">Configuring Proxy ARP (CLI Procedure)</a></li> <li><a href="#">Example: Configuring Proxy ARP on an EX Series Switch</a></li> <li><a href="#">Configuring Gratuitous ARP on page 18</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                       |

## push

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>push;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</code><br><code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code><a href="#">input-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code><a href="#">output-vlan-map</a>]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | <p> <b>NOTE:</b> On EX4300 switches, <code>push</code> is not supported at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code> hierarchy level.</p> <p>Specify the VLAN rewrite operation to add a new VLAN tag to the top of the VLAN stack. An outer VLAN tag is pushed in front of the existing VLAN tag.</p> <p>You can use this statement on Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces; 10-Gigabit Ethernet LAN/WAN PIC; aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces; 100-Gigabit Ethernet Type 5 PIC with CFP; and Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces.</p> <p>If you include the <b>push</b> statement in the configuration, you must also include the <a href="#">pop</a> statement at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code> hierarchy level.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Stacking a VLAN Tag on page 493</a></li> <li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## push-push

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | push-push;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>Specify the VLAN rewrite operation to push two VLAN tags in front of the frame.</p> <p>You can use this statement on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP.</p>                                                                                                                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Stacking Two VLAN Tags on page 494</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                |

## quiet-period

|                                 |                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>quiet-period seconds;</code>                                                                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | <code>[edit protocols dot1x authenticator interface <i>interface-id</i>]</code>                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.                                                                                                                                        |
| <b>Options</b>                  | <p><b>seconds</b>—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.</p> <p><b>Range:</b> 0 through 65,535 seconds</p> <p><b>Default:</b> 60 seconds</p>                                  |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authenticator on page 881</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> </ul> |

## quiet-period (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>quiet-period seconds;</code>                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>])]</code>                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                             |
| <b>Description</b>              | For 802.1X and captive portal authentication, configure the number of seconds the interface remains in the wait state following a failed authentication attempt by a supplicant before reattempting authentication. |
| <b>Default</b>                  | 60 seconds                                                                                                                                                                                                          |
| <b>Options</b>                  | <p><b>seconds</b>—Number of seconds the interface remains in the wait state.</p> <p><b>Range:</b> 0 through 65,535 seconds</p> <p><b>Default:</b> 60 seconds</p>                                                    |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                      |

## rate

---

|                                 |                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>rate {<br/>    (fixed-stuff-bytes   no-fixed-stuff-bytes);<br/>    otu4; oc192;<br/>    (pass-through   no-pass-through);<br/>}</pre>                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement and <b>otu4</b> option introduced in Junos OS Release 13.2 for PTX Series routers.<br>Option <b>oc192</b> introduced in Junos OS Release 13.3 for MX Series routers.                                                                                |
| <b>Description</b>              | Specify the line rate or speed of the OTN signals.                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li></ul> |



## reauthentication

|                                 |                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | reauthentication (disable   interval <i>seconds</i> );                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols dot1x authenticator interface <i>interface-id</i> ]                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Set or disable the periodic reauthentication of the client.                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <ul style="list-style-type: none"> <li>• <b>disable</b>—Disable the periodic reauthentication of the client.</li> <li>• <b>interval <i>seconds</i></b>—Specify the periodic reauthentication time interval.</li> </ul> <p><b>Range:</b> 1 through 65,535 seconds<br/> <b>Default:</b> 3600 seconds</p>  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> <li>• <a href="#">quiet-period on page 1147</a></li> </ul> |

## reauthentication (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | reauthentication <i>interval</i> ;                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ]) dot1x]                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                    |
| <b>Description</b>              | For 802.1X authentication, specify the number of seconds before an authentication session times out.                                                                       |
| <b>Options</b>                  | <p><b>interval</b>—Sets the periodic reauthentication time interval in seconds.</p> <p><b>Range:</b> 1 through 4,294,967,296 seconds<br/> <b>Default:</b> 3600 seconds</p> |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                        |

## rebalance (Aggregated Ethernet Interfaces)

---

|                                 |                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>rebalance <i>interval</i></code>                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces aeX <i>unit logical-unit-number</i> forwarding-options load-balance-stateful per-flow]                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2R1.                                                                                                                      |
| <b>Description</b>              | Configure periodic rebalancing of traffic flows of an aggregated Ethernet bundle by clearing the load balance state at a specified interval.                          |
| <b>Options</b>                  | <b>interval</b> —Number of minutes after which the load-balancing state must be cleared for the specified interface.<br><b>Range:</b> 1 through 1000 flows per minute |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 187</a></li></ul>                   |

## receive-ais

---

|                                 |                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>receive-ais;</code>                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management action-profile <i>action-profile-name</i> event ais-trigger-condition]                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                    |
| <b>Description</b>              | Send a message to the peer MEPs when an AIS message is received by a peer MEP at its own maintenance level.                                                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li><li>• <a href="#">Configuring ETH-AIS on a CFM MEP on page 696</a></li></ul> |

## receive-options-packets

---

|                                 |                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | receive-options-packets;                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit <b>interfaces</b> <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> inet],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> inet] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                         |
| <b>Description</b>              | For a Monitoring Services PIC and an ATM or SONET/SDH PIC installed in an M160, M40e, or T Series router, guarantee conformity with cflowd records structure. This statement is required when you enable passive monitoring.                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Enabling Passive Monitoring on ATM Interfaces</i></li> <li>• <i>Enabling Packet Flow Monitoring on SONET/SDH Interfaces</i></li> </ul>                                                                        |

## receive-ttl-exceeded

---

|                                 |                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | receive-ttl-exceeded;                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit <b>interfaces</b> <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> inet],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> inet] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                         |
| <b>Description</b>              | For Monitoring Services PIC and an ATM or SONET/SDH PIC installed in an M160, M40e, or T Series router, guarantee conformity with cflowd records structure. This statement is required when you enable passive monitoring.                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Enabling Passive Monitoring on ATM Interfaces</i></li> <li>• <i>Enabling Packet Flow Monitoring on SONET/SDH Interfaces</i></li> </ul>                                                                        |

## remote

---

|                                 |                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>remote {<br/>    (inet-address <i>address</i>   mac-address <i>address</i>);<br/>}</pre>                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>tcc</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> <b>family</b> <i>tcc</i> ]                                                                                |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | For Layer 2.5 VPNs using an Ethernet interface as the TCC router, configure the location of the remote router. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only.  |
| <b>Options</b>                  | <b>mac-address</b> —Configure the MAC address of the remote site.<br><br><b>inet-address</b> —Configure the IP address of the remote site.                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Translation Cross-Connect Interface Switching on page 353</a></li><li>• <a href="#">Example: Configuring an Ethernet TCC or Extended VLAN TCC on page 353</a></li><li>• <a href="#">proxy on page 1143</a></li><li>• <i>Junos OS VPNs Library for Routing Devices</i></li></ul> |

## remote-loopback

---

|                                 |                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>remote-loopback;</pre>                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <b>oam</b> <b>link-fault-management</b> <b>interface</b> <i>interface-name</i> ]                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.2.                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | For Ethernet interfaces on EX Series switches and M320, M120, MX Series, and T Series routers, set the remote DTE into loopback mode. Remove the statement from the configuration to take the remote DTE out of loopback mode. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support. |
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.<br><b>interface-control</b> —To add this statement to the configuration.                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Setting a Remote Interface into Loopback Mode on page 610</a></li></ul>                                                                                                                                                                                   |

## remote-maintenance-association (OAM)

|                                 |                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>remote-maintenance-association <i>remote-ma-name</i>;</code>                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">maintenance-domain</a> <i>domain-name</i> <a href="#">maintenance-association</a> <i>ma-name</i> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.4.                                                                                                                                                                            |
| <b>Description</b>              | Configure the name of the remote maintenance association.                                                                                                                                                                 |
| <b>Options</b>                  | <i>remote-ma-name</i> —Name of the remote maintenance association.                                                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> </ul>                                                                        |

## remote-mep

|                                 |                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>remote-mep <i>mep-id</i> {   <a href="#">action-profile</a> <i>profile-name</i>;   <a href="#">sla-iterator-profile</a> <i>profile-name</i> {     <a href="#">data-tlv-size</a> <i>size</i>;     <a href="#">iteration-count</a> <i>count-value</i>;     <a href="#">priority</a> <i>priority-value</i>;   }   <a href="#">detect-loc</a>; }</pre> |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">connectivity-fault-management</a> <a href="#">maintenance-domain</a> <i>md-name</i> <a href="#">maintenance-association</a> <i>ma-name</i> <a href="#">mep</a> <i>mep-id</i> ]                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Configure the numeric identifier of the remote maintenance association end point (MEP) within the maintenance association.                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><i>mep-id</i>—Numeric identifier of the MEP.</p> <p><b>Range:</b> 1 through 8191</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 530</a></li> <li>• <a href="#">detect-loc on page 925</a></li> </ul>                                                                                                                                                    |

## replay-window-size (MX Series)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>replay-window-size <i>number-of-packets</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> replay-protect]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>Specifies the size of the replay protection window.</p> <p>This statement has to be configured to enable replay protection.</p> <p>When MACsec is enabled on an Ethernet link, an ID number is assigned to each packet entering the link. The ID number of the packet is checked by the receiving interface after the packet has traversed the MACsec-enabled link.</p> <p>When replay protection is enabled, the sequence of the ID number of received packets are checked. If the packet arrives out of sequence and the difference between the packet numbers exceeds the replay protection window size, the packet is dropped by the receiving interface. For instance, if the replay protection window size is set to five and a packet assigned the ID of 1006 arrives on the receiving link immediately after the packet assigned the ID of 1000, the packet that is assigned the ID of 1006 is dropped because it falls outside the parameters of the replay protection window.</p> <p>Replay protection is especially useful for fighting man-in-the-middle attacks. A packet that is replayed by a man-in-the-middle attacker on the Ethernet link will arrive on the receiving link out of sequence, so replay protection helps ensure the replayed packet is dropped instead of forwarded through the network.</p> <p>Replay protection should not be enabled in cases where packets are expected to arrive out of order.</p> |
| <b>Default</b>                  | Replay protection is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <p><i>number-of-packets</i>—Specifies the size of the replay protection window, in packets.</p> <p>When this variable is set to 0, all packets that arrive out-of-order are dropped.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## replay-protect (MX Series)

---

|                                 |                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | replay-protect {<br>replay-window-size <i>number-of-packets</i> ;<br>}                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                      |
| <b>Description</b>              | <p>Enable replay protection for MACsec.</p> <p>A replay window size specified using the <b>replay-window-size <i>number-of-packets</i></b> statement must be specified to enable replay protection.</p> |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                      |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                  |

## restore-interval

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | restore-interval <i>number</i> ;                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                                                                                                |
| <b>Description</b>              | Configures the number of minutes that the node does not process any Ethernet ring protection (ERP) protocol data units (PDUs).. This configuration is a global configuration and applies to all Ethernet rings if the Ethernet ring does not have a more specific configuration for this value. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value.       |
| <b>Options</b>                  | <i>number</i> —Specify the restore interval.<br><b>Range:</b> 5 through 12 minutes                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li><li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li><li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li></ul> |



## retries

|                                 |                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>retries <i>integer</i>;</code>                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit protocols dot1x authenticator interface <i>interface-id</i> ]                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Set a limit on the number of failed authentication attempts between a port and a client. When the limit is exceeded, the port waits to reattempt authentication for the number of seconds set by the <b>quiet-period</b> statement configured at the same hierarchy level.                              |
| <b>Options</b>                  | <p><i>integer</i>—Specify the number of retries.</p> <p><b>Range:</b> 1 through 10</p> <p><b>Default:</b> 3 retries</p>                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> <li>• <a href="#">quiet-period on page 1147</a></li> </ul> |

## retries (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>retries <i>number</i>;</code>                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ])]                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                       |
| <b>Description</b>              | For 802.1X and captive portal authentication, configure the number of times the switch attempts to authenticate the port after an initial failure. The port remains in a wait state during the quiet period after the authentication attempt. |
| <b>Options</b>                  | <p><i>number</i>—Number of retries.</p> <p><b>Default:</b> 3 retries</p> <p><b>Range:</b> 1 through 10</p>                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                |

## revertive

---

|                            |                                                                                                                        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | revertive;                                                                                                             |
| <b>Hierarchy Level</b>     | [edit interfaces aeX aggregated-ether-options lacp link-protection]                                                    |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.3.<br>Statement introduced in Junos OS Release 12.3 for EX Series switches. |
| <b>Description</b>         | Enable the ability to switch to a better priority link (if one is available).                                          |



**NOTE:** By default, LACP link protection is revertive. However, you can use this statement to define a specific aggregated Ethernet interface as revertive to override a global non-revertive statement specified at the [edit chassis] hierarchy level.

---

|                                 |                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>non-revertive (Chassis)</i></li><li>• <i>Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)</i></li></ul> |

## ring-id

---

|                                 |                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ring-id <i>number</i> ;                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <b>protection-group ethernet-ring</b> <i>ring-name</i> ]                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                            |
| <b>Description</b>              | Specify the ring ID.                                                                                                                                                                                      |
| <b>Options</b>                  | <b>number</b> —Ring ID number.<br><b>Range:</b> 1 through 239<br><b>Default:</b> 1                                                                                                                        |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li></ul> |

## ring-protection-link-end

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ring-protection-link-end;                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring</a> <i>ring-name</i> ( <a href="#">east-interface</a>   <a href="#">west-interface</a> )]                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Specify that the port is one side of a ring protection link (RPL) by setting the RPL end flag.                                                                                                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li> <li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li> </ul> |

## ring-protection-link-owner

|                                 |                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | ring-protection-link-owner;                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring</a> <i>ring-name</i> ]                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                    |
| <b>Description</b>              | Specify the ring protection link (RPL) owner flag in the Ethernet protection ring. Include this statement only once for each ring (only one node can function as the RPL owner).                                                                                                                                                                          |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li> <li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li> </ul> |

## routing-instance

---

|                                 |                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>routing-instance {<br/>    destination <i>routing-instance-name</i>;<br/>}</pre>                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> tunnel],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> tunnel] |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                   |
| <b>Description</b>              | To configure <b>interfaces</b> and <b>logical-systems</b> , specify the destination routing instance that points to the routing table containing the tunnel destination address.                                    |
| <b>Default</b>                  | The default Internet routing table is <b>inet.0</b> .                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Junos OS Services Interfaces Library for Routing Devices</i></li></ul>                                                                                                   |

## routing-instance (PPPoE Service Name Tables)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>routing-instance <i>routing-instance-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i> ],<br>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b><br><i>aci circuit-id-string ari remote-id-string</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Use in conjunction with the <b>dynamic-profile</b> statement at the same hierarchy levels to specify the routing instance in which to instantiate a dynamic PPPoE interface. You can associate a routing instance with a named service entry, <b>empty</b> service entry, or <b>any</b> service entry configured in a PPPoE service name table, or with an agent circuit identifier/agent remote identifier (ACI/ARI) pair defined for these services.</p> <p>The routing instance associated with a service entry in a PPPoE service name table overrides the routing instance associated with the PPPoE underlying interface on which the dynamic PPPoE interface is created.</p> <p>If you include the <b>routing-instance</b> statement at the [edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> agent-specifier aci <i>circuit-id-string</i> ari <i>remote-id-string</i>] hierarchy level, you cannot also include the <b>static-interface</b> statement at this level. The <b>routing-instance</b> and <b>static-interface</b> statements are mutually exclusive for ACI/ARI pair configurations.</p> |
| <b>Options</b>                  | <b><i>routing-instance-name</i></b> —Name of the routing instance in which the router instantiates the dynamic PPPoE interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Configuring PPPoE Service Name Tables</li> <li>Assigning a Dynamic Profile and Routing Instance to a Service Name or ACI/ARI Pair for Dynamic PPPoE Interface Creation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## sa-multicast (100-Gigabit Ethernet)

|                            |                                                                                                                      |
|----------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | sa-multicast;                                                                                                        |
| <b>Hierarchy Level</b>     | [edit chassis fpc slot pic slot forwarding-mode]                                                                     |
| <b>Release Information</b> | Statement introduced in Junos OS Release 10.4.                                                                       |
| <b>Description</b>         | Configure the 100-Gigabit Ethernet PIC or MIC to interoperate with other Juniper Networks 100-Gigabit Ethernet PICs. |



**NOTE:** The default packet steering mode for PD-ICE-CFP-FPC4 is SA multicast bit mode. No SA multicast configuration is required to enable this mode.

sa-multicast supports interoperability between the following PICs and MICs:

- 100-Gigabit Ethernet Type 5 PIC with CFP (PF-1CGE-CFP) and the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4) .
- 100-Gigabit Ethernet MICs and the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4).

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"> <li>• <a href="#">Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-1CGE-CFP on page 410</a></li> <li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4 on page 413</a></li> <li>• <a href="#">Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-ICE-CFP-FPC4) Using SA Multicast Mode</a></li> <li>• <a href="#">Interoperability Between MPC4E (MPC4E-3D-2CGE-8XGE) and 100-Gigabit Ethernet PICs on Type 4 FPC</a></li> <li>• <a href="#">Configuring MPC4E (MPC4E-3D-2CGE-8XGE) to Interoperate with 100-Gigabit Ethernet PICs on Type 4 FPC Using SA Multicast Mode</a></li> <li>• <a href="#">Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 411</a></li> <li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 415</a></li> <li>• <a href="#">forwarding-mode (100-Gigabit Ethernet) on page 974</a></li> <li>• <a href="#">sa-multicast (PTX Series Packet Transport Routers) on page 1163</a></li> <li>• <a href="#">vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1245</a></li> </ul> |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- [Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 406](#)

## sa-multicast (PTX Series Packet Transport Routers)

|                            |                                                                                                                                                                               |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | sa-multicast;                                                                                                                                                                 |
| <b>Hierarchy Level</b>     | [edit chassis fpc slot pic slot port <i>port-number</i> forwarding-mode]                                                                                                      |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.1X48R4.                                                                                                                           |
| <b>Description</b>         | Configure source address (SA) multicast bit mode on the 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP to enable interoperability with 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4. |



**NOTE:** When SA multicast bit steering mode is configured on a PTX Series Packet Transport Router 100-Gigabit Ethernet port, VLANs are not supported for that port.

|                                 |                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 411</a></li> <li>• <a href="#">Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-1CE-CFP-FPC4 on page 415</a></li> </ul> |

## secure-authentication (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | secure-authentication (http   https);                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit protocols captive-portal-custom-options]                                                                                                                 |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                        |
| <b>Description</b>              | Enable HTTP or HTTPS access on the captive portal interface.                                                                                                   |
| <b>Default</b>                  | http                                                                                                                                                           |
| <b>Options</b>                  | <b>http</b> —Enables HTTP access on the captive portal interface.<br><b>https</b> —Enables HTTPS access on the captive portal interface. HTTPS is recommended. |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                            |



## secure-channel

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> secure-channel <i>secure-channel-name</i> {     direction (inbound   outbound);     encryption (MACsec);     id {         mac-address <i>mac-address</i>;         port-id <i>port-id-number</i>;     }     offset (0 30 50);     security-association <i>security-association-number</i> {         key <i>key-string</i>;     } } </pre>                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Create and configure a secure channel to enable and configure MACsec when MACsec is enabled using static secure association key (SAK) security mode.</p> <p>You do not need to use this option to enable MACsec using static connectivity association key (CAK) security mode. All configuration for MACsec using static CAK security mode is done inside of the connectivity association but outside of the secure channel. When MACsec is enabled using static CAK security mode, an inbound and an outbound secure channel—neither of which is user-configurable—is automatically created within the connectivity association.</p> |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## security-association

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>security-association <i>security-association-number</i> {<br/>    key <i>key-string</i>;<br/>}</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit security macsec connectivity-association <i>connectivity-association-name</i> secure-channel <i>secure-channel-name</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | <p>Specifies the number of one of the security associations in the secure channel when MACsec is enabled using static secure association key (SAK) security mode. Because SAKs are created by the key server when MACsec is enabled using static connectivity association key (CAK) security mode, the <b>security-association</b> statement is not used when enabling MACsec using static CAK security mode.</p> <p>You must configure at least two security associations to enable MACsec using static SAK security mode. MACsec initially establishes a secure connection when a security association number and key match on both ends of an Ethernet link. After a certain number of Ethernet frames are securely transmitted across the Ethernet link, MACsec automatically rotates to a new security association with a new security association number and key to maintain the secured Ethernet link. This rotation continues each time a certain number of Ethernet frames are securely transmitted across the secured Ethernet link, so you must always configure MACsec to have at least two security associations.</p> |
| <b>Default</b>                  | No security keys are configured, by default.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | <p><b><i>security-association-number</i></b>—Specifies the security association number and creates the SAK.</p> <p>The security association number is a whole number between 0 and 3. You can configure two security associations in a secure channel when enabling MACsec using static security keys.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b> | admin—To view this statement in the configuration.<br>admin-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## send-critical-event

---

|                                 |                                                                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | send-critical-event;                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam</a> <a href="#">ethernet</a> <a href="#">link-fault-management</a> <a href="#">action-profile</a> <a href="#">action</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                              |
| <b>Description</b>              | Send OAM PDUs with the critical event bit set.                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Specifying the Actions to Be Taken for Link-Fault Management Events on page 605</a></li> </ul>        |

## server

---

|                                 |                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | server;                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces pp0 unit <i>logical-unit-number</i> <a href="#">pppoe-options</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces pp0 <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">pppoe-options</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                                                                                                            |
| <b>Description</b>              | Configure the router to operate in the PPPoE server mode. Supported on M120 and M320 Multiservice Edge Routers and MX Series Universal Edge Routers operating as access concentrators.                                                   |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring the PPPoE Server Mode on page 331</a></li> </ul>                                                                                                                        |

## server-fail

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>server-fail (deny   permit   use-cache   <i>vlan-id</i>   <i>vlan-name</i>);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>]) dot1x]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | <p>For EX Series switches configured for 802.1X authentication, specify the server fail fallback action the switch takes when all RADIUS authentication servers are unreachable.</p> <p>When you specify the action <i>vlan-name</i> or <i>vlan-id</i>, the VLAN must already be configured on the switch.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Default</b>                  | Authentication is denied.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Options</b>                  | <p><b>deny</b>—Force fail the supplicant authentication. No traffic will flow through the interface.</p> <p><b>permit</b>—Force succeed the supplicant authentication. Traffic will flow through the interface as if it were successfully authenticated by the RADIUS server.</p> <p><b>use-cache</b>—Force succeed the supplicant authentication only if it was previously authenticated successfully. This action ensures that already authenticated supplicants are not affected.</p> <p><b>vlan-id</b>—Move supplicant on the interface to the VLAN specified by this numeric identifier. This action is allowed only if it is the first supplicant connecting to the interface. If an authenticated supplicant is already connected, then the supplicant is not moved to the VLAN and is not authenticated.</p> <p><b>vlan-name</b>—Move supplicant on the interface to the VLAN specified by this name. This action is allowed only if it is the first supplicant connecting to an interface. If an authenticated supplicant is already connected, then the supplicant is not moved to the VLAN and is not authenticated.</p> |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## server-reject-vlan (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>server-reject-vlan (<i>vlan-id</i>   <i>vlan-name</i>) {     eapol-block;     block-interval <i>block-interval</i>; }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ]) dot1x]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>For EX Series switches configured for 802.1X authentication, specify that when the switch receives an Extensible Authentication Protocol Over LAN (EAPoL) Access-Reject message during the authentication process between the switch and the RADIUS authentication server, supplicants attempting access to the LAN are granted access and moved to a specific VLAN. Any VLAN name or VLAN ID sent by a RADIUS server as part of the EAPoL Access-Reject message is ignored.</p> <p>When you specify the VLAN ID or VLAN name, the VLAN must already be configured on the switch.</p> <p>The remaining statements are explained separately.</p> |
| <b>Default</b>                  | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <p><b><i>vlan-id</i></b>—Numeric identifier of the VLAN to which the supplicant is moved.</p> <p><b><i>vlan-name</i></b>—Name of the VLAN to which the supplicant is moved.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## server-timeout

---

|                                 |                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>server-timeout <i>seconds</i>;</code>                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | <code>[edit protocols dot1x authenticator interface <i>interface-id</i>]</code>                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                      |
| <b>Description</b>              | Sets the number of seconds the port waits for a reply when relaying a response from the client to the authentication server before timing out and invoking the server-fail action.                                                                                                                 |
| <b>Options</b>                  | <b><i>seconds</i></b> —The number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.<br><b>Range:</b> 1 through 60 seconds<br><b>Default:</b> 30 seconds                                                  |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li><li>• <a href="#">authenticator on page 881</a></li><li>• <a href="#">dot1x on page 931</a></li><li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li></ul> |

## server-timeout (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>server-timeout <i>seconds</i>;</code>                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>])]</code>                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                  |
| <b>Description</b>              | For 802.1X and captive portal authentication, configure the amount of time a port will wait for a reply when relaying a response from the supplicant to the authentication server before timing out and invoking the server-fail action. |
| <b>Default</b>                  | 30 seconds                                                                                                                                                                                                                               |
| <b>Options</b>                  | <b><i>seconds</i></b> —Number of seconds.<br><b>Range:</b> 1 through 60 seconds<br><b>Default:</b> 30 seconds                                                                                                                            |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                      |

## service (PPPoE)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> service service-name {     drop;     delay seconds;     terminate;     dynamic-profile profile-name;     routing-instance routing-instance-name;     max-sessions number;     agent-specifier {         aci circuit-id-string ari remote-id-string {             drop;             delay seconds;             terminate;             dynamic-profile profile-name;             routing-instance routing-instance-name;             static-interface interface-name;         }     } } </pre>                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols pppoe <b>service-name-tables</b> table-name]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 10.0.</p> <p><b>any</b>, <b>dynamic-profile</b>, <b>routing-instance</b>, <b>max-sessions</b>, and <b>static-interface</b> options introduced in Junos OS Release 10.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | <p>Specify the action taken by the interface on receipt of a PPPoE Active Discovery Initiation (PADI) control packet for the specified named service, <b>empty</b> service, or <b>any</b> service in a PPPoE service name table. You can also specify the dynamic profile and routing instance that the router uses to instantiate a dynamic PPPoE interface, and the maximum number of active PPPoE sessions that the router can establish with the specified service.</p>                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Default</b>                  | The default action is terminate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p><b>service-name</b>—Service entry in the PPPoE service name table:</p> <ul style="list-style-type: none"> <li>• <b>service-name</b>—Named service entry of up to 32 characters; for example, <b>premiumService</b>. You can configure a maximum of 512 named service entries across all PPPoE service name tables on the router.</li> <li>• <b>empty</b>—Service entry of zero length that represents an unspecified service. Each PPPoE service name table includes one <b>empty</b> service entry by default.</li> <li>• <b>any</b>—Default service for non-empty service entries that do not match the named or <b>empty</b> service entries configured in the PPPoE service name table. Each PPPoE service name table includes one <b>any</b> service entry by default.</li> </ul> <p>The remaining statements are explained separately.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

- Related Documentation**
- *Configuring PPPoE Service Name Tables*
  - *Assigning a Service to a Service Name Table and Configuring the Action Taken When the Client Request Includes a Non-zero Service Name Tag*
  - *Configuring the Action Taken When the Client Request Includes an Empty Service Name Tag*
  - *Configuring the Action Taken for the Any Service*

---


## service-name

---

- Syntax** `service-name name;`
- Hierarchy Level** [edit interfaces pp0 unit *logical-unit-number* [pppoe-options](#)],  
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* [pppoe-options](#)]
- Release Information** Statement introduced before Junos OS Release 7.4.
- Description** PPP over Ethernet interfaces, configure the service to be requested from the PPP over Ethernet server; that is, the access concentrator. For example, you can use this statement to indicate an Internet service provider (ISP) name or a class of service.
- Options** *name*—Service to be requested from the PPP over Ethernet server.
- Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.
- Related Documentation**
- [Configuring the PPPoE Service Name on page 331](#)
  - *Junos OS Interfaces and Routing Configuration Guide*



## service-name-table

|                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                            | <code>service-name-table <i>table-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>                                                                                                                                                                                   | <p>[edit dynamic-profiles <i>profile-name</i> interfaces demux0 unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit dynamic-profiles <i>profile-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">pppoe-underlying-options</a>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family pppoe],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">pppoe-underlying-options</a>]</p> |
| <b>Release Information</b>                                                                                                                                                                               | <p>Statement introduced in Junos OS Release 10.0.</p> <p>Support at the [edit ... family pppoe] hierarchies introduced in Junos OS Release 11.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>                                                                                                                                                                                       | Specify the PPPoE service name table assigned to a PPPoE underlying interface. This underlying interface is configured with either the <b>encapsulation ppp-over-ether</b> statement or the <b>family pppoe</b> statement; the two statements are mutually exclusive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <div>  <b>NOTE:</b> The [edit ... family pppoe] hierarchies are supported only on MX Series routers with MPCs. </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                                                                                                                                                                                           | <b><i>table-name</i></b> —Name of the PPPoE service name table, a string of up to 32 alphanumeric characters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b>                                                                                                                                                                          | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• <i>Configuring PPPoE Service Name Tables</i></li> <li>• <i>Assigning a Service Name Table to a PPPoE Underlying Interface</i></li> <li>• <i>Configuring the PPPoE Family for an Underlying Interface</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## service-name-tables

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> service-name-tables <i>table-name</i> {   service <i>service-name</i> {     drop;     delay <i>seconds</i>;     terminate;     dynamic-profile <i>profile-name</i>;     routing-instance <i>routing-instance-name</i>;     max-sessions <i>number</i>;     agent-specifier {       aci <i>circuit-id-string</i> ari <i>remote-id-string</i> {         drop;         delay <i>seconds</i>;         terminate;         dynamic-profile <i>profile-name</i>;         routing-instance <i>routing-instance-name</i>;         static-interface <i>interface-name</i>;       }     }   } } </pre> |
| <b>Hierarchy Level</b>          | [edit protocols pppoe]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | <p>Statement introduced in Junos OS Release 10.0.</p> <p><b>dynamic-profile</b>, <b>routing-instance</b>, <b>max-sessions</b>, and <b>static-interface</b> options introduced in Junos OS Release 10.2.</p>                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Create and configure a PPPoE service name table. Specify the action taken for each service and remote access concentrator on receipt of a PPPoE Active Discovery Initiation (PADI) packet. You can also specify the dynamic profile and routing instance that the router uses to instantiate a dynamic PPPoE interface, and the maximum number of active PPPoE sessions that the router can establish with the specified service. A maximum of 32 PPPoE service name tables is supported per router.</p>                                                                                       |
| <b>Options</b>                  | <p><b>table-name</b>—Name of the PPPoE service name table, a string of up to 32 alphanumeric characters.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>Configuring PPPoE Service Name Tables</li> <li>Creating a Service Name Table</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## session-expiry (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | session-expiry <i>seconds</i> ;                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ])]                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.             |
| <b>Description</b>              | Configure the maximum duration in seconds of a session.                                                             |
| <b>Options</b>                  | <i>seconds</i> —Duration of session.<br><b>Range:</b> 1 through 65535<br><b>Default:</b> 3600                       |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing—control—To add this statement to the configuration. |

## short-name-format

---

|                            |                                                                                                                                                                                                                                                                                     |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | short-name-format (character-string   vlan   2octet   rfc-2685-vpn-id);                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>     | [edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name <b>maintenance-association</b> ma-name]                                                                                                                                                   |
| <b>Release Information</b> | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                                                          |
| <b>Description</b>         | Specify the name format of the maintenance association name.                                                                                                                                                                                                                        |
| <b>Options</b>             | <b>character-string</b> —The name is an ASCII character string.<br><b>vlan</b> —The primary VLAN identifier.<br><b>2octet</b> —A number in the range 0 through 65,535.<br><b>rfc-2685-vpn-id</b> —A VPN identifier that complies with RFC 2685.<br><b>Default:</b> character-string |



**NOTE:** The PTX Series Packet Transport Routers support the vlan and 2octet options only.

---


|                                 |                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Creating a Maintenance Association on page 528</a></li><li>• <i>Configuring Ethernet 802.1ag OAM on PTX Series Packet Transport Routers</i></li></ul> |

## signal-degrade

---

|                                 |                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> signal-degrade {   ber-threshold-clear <i>value</i>;   ber-threshold-signal-degrade <i>value</i>;   interval <i>value</i>; } </pre>                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.<br>Statement introduced in Junos OS Release 13.3 for MX Series routers.                                                                                                                                                                      |
| <b>Description</b>              | Specify bit error rate (BER) signal degradation thresholds and time interval for raising and clearing alarms for optical transport network (OTN) links.                                                                                                                                                            |
| <b>Default</b>                  | If you omit the <b>signal-degrade</b> statement, the default threshold values are used.                                                                                                                                                                                                                            |
| <b>Options</b>                  | The remaining statements are explained separately.                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## signal-degrade-monitor-enable

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (signal-degrade-monitor-enable   no-signal-degrade-monitor-enable);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options preemptive-fast-reroute</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>Enable or disable pre-forward error correction (FEC) bit error rate (BER) monitoring.</p> <p>With pre-FEC BER monitoring enabled, when the configured pre-FEC BER signal degrade threshold is reached, the PIC stops forwarding packets to the remote interface and raises an interface alarm. Ingress packets continue to be processed. If pre-FEC BER monitoring is used with MPLS fast reroute or another link protection method, then traffic is rerouted to a different interface.</p> <p>You can also configure backward fast reroute to insert local pre-FEC BER status into transmitted OTN frames, notifying the remote interface of signal degradation. The remote interface can use the information to reroute traffic to a different interface. If you use pre-FEC BER monitoring together with backward fast reroute, then notification of signal degradation and rerouting of traffic occurs in less time than that required through a Layer 3 protocol. To configure backward fast reroute, include the <b>backward-frr-enable</b> statement at the same hierarchy level.</p> |
|                                 | <p> <b>NOTE:</b> When you configure pre-FEC BER signal degrade monitoring, we recommend that you configure both the <b>signal-degrade-monitor-enable</b> and <b>backward-frr-enable</b> statements.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                 | <p>You can also configure the pre-FEC BER thresholds that raise or clear a signal degrade alarm and the time interval for the thresholds. If the BER thresholds and interval are not configured, the default values are used. Include the <b>ber-threshold-signal-degrade value</b>, <b>ber-threshold-clear value</b>, and <b>interval value</b> statements at the [edit interfaces <i>interface-name</i> <b>otn-options signal-degrade</b>] hierarchy level to configure the BER thresholds and time interval. See “Understanding Pre-FEC BER Monitoring and BER Thresholds” on <a href="#">page 431</a> for more information about pre-FEC BER monitoring and determining BER threshold settings.</p>                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Default</b>                  | By default, pre-FEC BER signal degrade monitoring is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b>signal-degrade-monitor-enable</b>—Enable pre-FEC BER signal degrade monitoring.</p> <p><b>no-signal-degrade-monitor-enable</b>—Do not enable pre-FEC BER signal degrade monitoring.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

- Related Documentation**
- [Understanding Pre-FEC BER Monitoring and BER Thresholds on page 431](#)
  - [100-Gigabit Ethernet OTN Options Configuration Overview on page 430](#)
  - [Configuring 100-Gigabit DWDM OTN PICs on page 435](#)

## source-address-filter

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | source-address-filter {<br><i>mac-address</i> ;<br>}                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Hierarchy Level          | [edit interfaces <i>interface-name</i> <a href="#">aggregated-ether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">fastether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Release Information      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description              | For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, Gigabit Ethernet IQ interfaces, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router), specify the MAC addresses from which the interface can receive packets. For this statement to have any effect, you must include the <b>source-filtering</b> statement in the configuration to enable source address filtering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Options                  | <p><b>mac-address</b>—MAC address filter. You can specify the MAC address as <i>nn:nn:nn:nn:nn:nn</i> or <i>nnnn.nnnn.nnnn</i>, where <i>n</i> is a decimal digit. To specify more than one address, include multiple <b>mac-address</b> options in the <b>source-address-filter</b> statement.</p> <p>If you enable the VRRP on a Fast Ethernet or Gigabit Ethernet interface, as described in <a href="#">“VRRP and VRRP for IPv6 Overview” on page 323</a>, and if you enable MAC source address filtering on the interface, you must include the virtual MAC address in the list of source MAC addresses that you specify in the <b>source-address-filter</b> statement. MAC addresses ranging from <b>00:00:5e:00:01:00</b> through <b>00:00:5e:00:01:ff</b> are reserved for VRRP, as defined in RFC 3768, <i>Virtual Router Redundancy Protocol</i>. When you configure the VRRP group, the group number must be the decimal equivalent of the last hexadecimal byte of the virtual MAC address.</p> <p>On untagged Gigabit Ethernet interfaces, you should not configure the <b>source-address-filter</b> statement and the <b>accept-source-mac</b> statement simultaneously. On tagged Gigabit Ethernet interfaces, you should not configure the <b>source-address-filter</b> statement and the <b>accept-source-mac</b> statement with an identical MAC address specified in both filters.</p> |
| Required Privilege Level | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">Configuring MAC Address Filtering for Ethernet Interfaces on page 13</a></li><li>• <a href="#">Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15</a></li><li>• <a href="#">source-filtering on page 1181</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |



## source-filtering


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (source-filtering   no-source-filtering);                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">aggregated-ether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">fastether-options</a> ],<br>[edit interfaces <i>interface-name</i> <a href="#">gigether-options</a> ]                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | <p>For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, and Gigabit Ethernet IQ interfaces only, enable the filtering of MAC source addresses, which blocks all incoming packets to that interface. To allow the interface to receive packets from specific MAC addresses, include the <b>source-address-filter</b> statement.</p> <p>If the remote Ethernet card is changed, the interface is no longer able to receive packets from the new card because it has a different MAC address.</p> |
| <b>Default</b>                  | Source address filtering is disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring MAC Address Filtering for Ethernet Interfaces on page 13</a></li> <li>• <a href="#">Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 15</a></li> <li>• <a href="#">accept-source-mac on page 855</a></li> <li>• <a href="#">source-address-filter on page 1180</a></li> </ul>                                                                                                                      |

## speed (Ethernet)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>speed (10m   100m   1g   auto   auto-10m-100m);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i>],</code><br><code>[edit interfaces <i>ge-pim</i>/0/0 <i>switch-options</i> <i>switch-port</i> <i>port-number</i>]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.<br>Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Configure the interface speed. This statement applies to the management Ethernet interface (<b>fxp0</b> or <b>em0</b>), Fast Ethernet 12-port and 48-port PICs, the built-in Fast Ethernet port on the FIC (M7i router), Combo Line Rate DPCs and Tri-Rate Ethernet Copper interfaces on MX Series routers, and Gigabit Ethernet interfaces on EX Series switches.</p> <p>When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled. When you configure 100BASE-FX SFP, you must set the port speed at 100 Mbps.</p>                                                                                                                                                       |
| <b>Options</b>                  | <p>You can specify the speed as either <b>10m</b> (10 Mbps), <b>100m</b> (100 Mbps), and on MX Series routers, <b>1g</b> (1 Gbps). You can also specify the <b>auto</b> option on MX Series routers.</p> <p>For Gigabit Ethernet interfaces on EX Series switches, you can specify one of the following options:</p> <ul style="list-style-type: none"><li>• <b>10m</b>—10 Mbps</li><li>• <b>100m</b>—100 Mbps</li><li>• <b>1g</b>—1 Gbps</li><li>• <b>auto</b>—Automatically negotiate the speed (10 Mbps, 100 Mbps, or 1 Gbps) based on the speed of the other end of the link.</li><li>• <b>auto-10m-100m</b>—Automatically negotiate the speed (10 Mbps or 100 Mbps) based on the speed of the other end of the link.</li></ul> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring the Interface Speed</i></li><li>• <a href="#">Configuring the Interface Speed on Ethernet Interfaces on page 8</a></li><li>• <i>Configuring Gigabit Ethernet Autonegotiation</i></li><li>• <i>Configuring Gigabit Ethernet Interfaces (CLI Procedure)</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                          |

## speed (MX Series DPC)

|                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                        | <code>speed (auto   1Gbps   100Mbps   10Mbps);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                               | [edit interfaces <i>ge-fpc/pic/port</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>                                                                                                                                                                                                                           | Statement introduced in Junos OS Release 9.5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>                                                                                                                                                                                                                                   | On MX Series routers with Combo Line Rate DPCs and Tri-Rate Copper SFPs you can set auto negotiation of speed. To specify the auto negotiation speed, use the <b>speed (auto   1Gbps   100Mbps   10Mbps)</b> statement under the [edit interface <i>ge-/fpc/pic/port</i> ] hierarchy level. The <b>auto</b> option will attempt to automatically match the rate of the connected interface. To set port speed negotiation to a specific rate, set the port speed to <b>1Gbps</b> , <b>100Mbps</b> , or <b>10Mbps</b> . |
| <div>  <p><b>NOTE:</b> If the negotiated speed and the interface speed do not match, the link will not be brought up. Half duplex mode is not supported.</p> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>                                                                                                                                                                                                                                       | You can specify the speed as either <b>auto</b> (autonegotiate), <b>10Mbps</b> (10 Mbps), <b>100Mbps</b> (100 Mbps), or <b>1Gbps</b> (1 Gbps).                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                      | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li><i>Configuring Gigabit Ethernet Autonegotiation</i></li> <li><a href="#">no-auto-mdix on page 1081</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                               |

## sla-iterator-profile

---


|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>sla-iterator-profile <i>profile-name</i> {<br/>    <b>data-tlv-size</b> <i>size</i>;<br/>    <b>iteration-count</b> <i>count-value</i>;<br/>    <b>priority</b> <i>priority-value</i>;<br/>}</code>                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit protocols <b>oam ethernet connectivity-fault-management maintenance-domain</b><br><i>md-name</i> <b>maintenance-association</b> <i>ma-name</i> <b>mep</b> <i>mep-id</i> <b>remote-mep</b> <i>remote-mep-id</i> ]                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Configure a remote MEP with an iterator profile and specify the options.                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | <b><i>profile-name</i></b> —Name of the iterator profile configured for a remote MEP. For more information about configuring a remote MEP with an iterator profile, see <a href="#">“Configuring a Remote MEP with an Iterator Profile” on page 662</a> .<br><br>The remaining statements are explained separately.                                                                                                            |
| <b>Required Privilege Level</b> | Configure—To enter configuration mode.<br>Control—To modify any configuration.                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring an Iterator Profile on page 652</a></li><li>• <a href="#">Configuring a Remote MEP with an Iterator Profile on page 662</a></li><li>• <a href="#">Verifying the Configuration of an Iterator Profile on page 654</a></li><li>• <a href="#">Managing Iterator Statistics on page 657</a></li><li>• <a href="#">sla-iterator-profiles on page 1185</a></li></ul> |

## sla-iterator-profiles

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>sla-iterator-profiles {   profile-name {     avg-fd-twoway-threshold;     avg-ifdv-twoway-threshold;     avg-flr-forward-threshold;     avg-flr-backward-threshold;     calculation-weight {       delay delay-weight;       delay-variation delay-variation-weight;     }     cycle-time milliseconds;     iteration-period iteration-period-value;     measurement-type (loss   statistical-frame-loss   two-way-delay);   } }</pre> |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet connectivity-fault-management performance-monitoring</a> ]                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Configure an iterator application and specify the iterator profile options.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <p><b>profile-name</b>—Name of the iterator profile. For more information about configuring the iterator profile, see <a href="#">“Configuring an Iterator Profile” on page 652</a>.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                          |
| <b>Required Privilege Level</b> | <p>Configure—To enter configuration mode.</p> <p>Control—To modify any configuration.</p>                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring an Iterator Profile on page 652</a></li> <li>• <a href="#">Configuring a Remote MEP with an Iterator Profile on page 662</a></li> <li>• <a href="#">Verifying the Configuration of an Iterator Profile on page 654</a></li> <li>• <a href="#">Managing Iterator Statistics on page 657</a></li> </ul>                                                                      |

## stacked-vlan-tagging

---

|                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                 | stacked-vlan-tagging;                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>                                                                                                                                        | [edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>                                                                                                                                    | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.                                                                                                                                                                                                              |
| <b>Description</b>                                                                                                                                            | <p>For Gigabit Ethernet IQ interfaces, Gigabit Ethernet, 10-Gigabit Ethernet LAN/WAN PIC, and 100-Gigabit Ethernet Type 5 PIC with CFP, enable stacked VLAN tagging for all logical interfaces on the physical interface.</p> <p>For pseudowire subscriber interfaces, enable stacked VLAN tagging for logical interfaces on the pseudowire service.</p> |
| <div> <b>NOTE:</b> This statement is not supported on PTX1000 routers.</div> |                                                                                                                                                                                                                                                                                                                                                          |
| <b>Required Privilege Level</b>                                                                                                                               | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>                                                                                                                                  | <ul style="list-style-type: none"><li>• <a href="#">Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 483</a></li><li>• <a href="#">vlan-tags (Stacked VLAN Tags) on page 1250</a></li></ul>                                                                                                                                            |

## static (Protocols 802.1X)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>static <i>mac-address</i> {     interface <i>interface-names</i>;     vlan-assignment (<i>vlan-id</i>   <i>vlan-name</i> ); }</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Configure MAC addresses to exclude from 802.1X authentication. The static MAC list provides an authentication bypass mechanism for supplicants connecting to a port, permitting devices such as printers that are not 802.1X-enabled to be connected to the network on 802.1X-enabled ports.</p> <p>Using this 802.1X authentication-bypass mechanism, the supplicant connected to the MAC address is assumed to be successfully authenticated and the port is opened for it. No further authentication is done for the supplicant.</p> <p>You can optionally configure the VLAN that the supplicant is moved to or the interfaces on which the MAC address can gain access from.</p> |
| <b>Options</b>                  | <p><b><i>mac-address</i></b> —The MAC address of the device for which 802.1X authentication should be bypassed and the device permitted access to the port.</p> <p>The remaining statements are explained separately.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## static-interface

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>static-interface <i>interface-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b> <i>aci circuit-id-string ari remote-id-string</i> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Reserve the specified static PPPoE interface for use only by the PPPoE client with matching agent circuit identifier (ACI) and agent remote identifier (ARI) information. You can specify only one static interface per ACI/ARI pair configured for a named service entry, <b>empty</b> service entry, or <b>any</b> service entry in the PPPoE service name table.</p> <p>The static interface associated with an ACI/ARI pair takes precedence over the general pool of static interfaces associated with the PPPoE underlying interface.</p> <p>If you include the <b>static-interface</b> statement in the configuration, you cannot also include either the <b>dynamic-profile</b> statement or the <b>routing-instance</b> statement. The <b>dynamic-profile</b>, <b>routing-instance</b>, and <b>static-interface</b> statements are mutually exclusive for ACI/ARI pair configurations.</p> |
| <b>Options</b>                  | <b><i>interface-name</i></b> —Name of the static PPPoE interface reserved for use by the PPPoE client with matching ACI/ARI information. Specify the interface in the format <b>pp0.<i>logical</i></b> , where <b><i>logical</i></b> is a logical unit number from 0 through 16385 for static interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring PPPoE Service Name Tables</i></li><li>• <i>Reserving a Static PPPoE Interface for Exclusive Use by a PPPoE Client</i></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



## start-measurement

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | (no-start-measurement   start-measurement);                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>otn-options</b> <b>odu-delay-management</b> ]                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                |
| <b>Description</b>              | Start or do not start a delay measurement (DM) session.                                                                                                                                                              |
| <b>Default</b>                  | By default, do not start a DM session.                                                                                                                                                                               |
| <b>Options</b>                  | <b>no-start-measurement</b> —Do not start a DM session.<br><b>start-measurement</b> —Start a DM session.                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul> |

## supplicant

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | supplicant <i>single</i> ;                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols dot1x authenticator interface <i>interface-id</i> ]                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | <p>Specify the supplicant mode. Only single mode is supported.</p> <p>This option will authenticate only the first client that connects to a port. All other clients that connect later (802.1x compliant or non-compliant) will be allowed free access on that port without any further authentication. If the first authenticated client logs out, all other users are locked out until a client authenticates again.</p> |
| <b>Options</b>                  | <b>single</b> —Sets single mode.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authenticator on page 881</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> </ul>                                                                                                                     |

## supplicant (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | supplicant (multiple   single   single-secure);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control interface (all   [ <i>interface-names</i> ])]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | Configure the MAC-based method used to authenticate clients for 802.1X or captive portal authentication.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Default</b>                  | single                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Options</b>                  | <p><b>single</b>—Authenticates only the first client that connects to an authenticator port. All other clients connecting to the authenticator port after the first are permitted free access to the port without further authentication. If the first authenticated client logs out, all other supplicants are locked out until a client authenticates again.</p> <p><b>single-secure</b>—Authenticates only one client to connect to an authenticator port. The host must be directly connected to the switch.</p> <p><b>multiple</b>—Authenticates multiple clients individually on one authenticator port. You can configure the number of clients per port. If you also configure a maximum number of devices that can be connected to a port through port security settings, the lower of the configured values is used to determine the maximum number of clients allowed per port.</p> |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## supplicant-timeout

|                                 |                                                                                                                                                                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>supplicant-timeout <i>seconds</i>;</code>                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | <code>[edit protocols dot1x authenticator interface <i>interface-id</i>]</code>                                                                                                                                                                                                                         |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify the number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.                                                                                                                                          |
| <b>Options</b>                  | <p><b><i>seconds</i></b>—Specify the number of seconds the port waits for the supplicant timeout.</p> <p><b>Range:</b> 1 through 60 seconds</p> <p><b>Default:</b> 30 seconds</p>                                                                                                                       |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li> <li>• <a href="#">authenticator on page 881</a></li> <li>• <a href="#">dot1x on page 931</a></li> <li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li> </ul> |

## supplicant-timeout (MX Series in Enhanced LAN Mode)

|                                 |                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>supplicant-timeout <i>seconds</i>;</code>                                                                                                                                    |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>]) dot1x]</code>                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                            |
| <b>Description</b>              | For 802.1X authentication, configure how long the port waits for a response when relaying a request from the authentication server to the supplicant before resending the request. |
| <b>Default</b>                  | 30 seconds                                                                                                                                                                         |
| <b>Options</b>                  | <p><b><i>seconds</i></b> —Number of seconds.</p> <p><b>Range:</b> 1 through 60 seconds</p> <p><b>Default:</b> 30 seconds</p>                                                       |
| <b>Required Privilege Level</b> | <p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>                                                     |

## swap

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | swap;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ]                                                              |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Specify the VLAN rewrite operation to replace a VLAN tag. The outer VLAN tag of the frame is overwritten with the user-specified VLAN tag information.</p> <p>On MX Series routers, you can enter this statement on Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, aggregated Ethernet using Gigabit Ethernet IQ interfaces, and 100-Gigabit Ethernet Type 5 PIC with CFP. On EX Series switches, you can enter this statement on Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces.</p> |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Rewriting the VLAN Tag on Tagged Frames on page 496</a></li><li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                     |

## swap-by-poppush

---

|                                 |                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | swap-by-poppush;                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ]                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 11.2                                                                                                                                                                                                                                                                                                |
| <b>Description</b>              | For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, and aggregated Ethernet using Gigabit Ethernet IQ interfaces, specify the VLAN rewrite operation to replace a VLAN tag. Pop original tag, then push an entirely new tag. The swap operation is performed as pop followed by push. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                      |

## swap-push

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | swap-push;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Specify the VLAN rewrite operation to replace the outer VLAN tag of the frame with a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.<br><br>You can use this statement on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and 100-Gigabit Ethernet Type 5 PIC with CFP.     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Rewriting a VLAN Tag and Adding a New Tag on page 501</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                           |

## swap-swap

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | swap-swap;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.1.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Specify the VLAN rewrite operation to replace both the inner and the outer VLAN tags of the frame with a user-specified VLAN tag value.<br><br>You can use this statement on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, 10-Gigabit Ethernet LAN/WAN PIC, for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX Series routers, and for 100-Gigabit Ethernet Type 5 PIC with CFP.                                                                                            |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Rewriting the Inner and Outer VLAN Tags on page 502</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                             |

## switch-options

|                                 |                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | switch-options {<br>switch-port <i>port-number</i> {<br>( <a href="#">auto-negotiation</a>   no-auto-negotiation);<br><a href="#">speed</a> (10m   100m   1g);<br><a href="#">link-mode</a> (full-duplex   half-duplex);<br>}<br>} |
| <b>Hierarchy Level</b>          | [edit interfaces <i>ge-pim</i> /0/0]                                                                                                                                                                                               |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                      |
| <b>Description</b>              | Configuration of the physical port characteristics is done under the single physical interface.                                                                                                                                    |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                            |

## switch-port

---

|                                 |                                                                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>switch-port <i>port-number</i> {     (auto-negotiation   no-auto-negotiation);     speed (10m   100m   1g);     link-mode (full-duplex   half-duplex); }</pre>                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces <i>ge-pim/0/0</i> <b>switch-options</b> ]                                                                                                                                                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                          |
| <b>Description</b>              | Configuration of the physical port characteristics, done under the single physical interface.                                                                                                                                                                          |
| <b>Default</b>                  | Autonegotiation is enabled by default. If the link speed and duplex are also configured, the interfaces use the values configured as the desired values in the negotiation.                                                                                            |
| <b>Options</b>                  | <p><b><i>port-number</i></b>—Ports are numbered 0 through 5 on the 6-port Gigabit Ethernet uPIM, 0 through 7 on the 8-port Gigabit Ethernet uPIM, and 0 through 15 on the 16-port Gigabit Ethernet uPIM.</p> <p>The remaining statements are explained separately.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                     |

## symbol-period

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | symbol-period <i>count</i> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile event</a> , <a href="#">link-event-rate</a> ],<br>[edit protocols <a href="#">oam link-fault-management interface</a> <i>interface-name</i> <a href="#">event-thresholds</a> ]                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Configure the threshold for sending symbol period events or taking the action specified in the action profile.</p> <p>A symbol error is any symbol code error on the underlying physical layer. The symbol period threshold is reached when the number of symbol errors reaches the configured value within the period window. The default period window is the number of symbols that can be transmitted on the underlying physical layer in 1 second. The window is not configurable.</p> |
| <b>Options</b>                  | <p><b>count</b>—Threshold count for symbol period events.</p> <p><b>Range:</b> 0 through 100</p>                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Threshold Values for Local Fault Events on an Interface on page 600</a></li><li>• <a href="#">Configuring Threshold Values for Fault Events in an Action Profile on page 608</a></li></ul>                                                                                                                                                                                                                                     |

## syslog (OAM Action)

---

|                                 |                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | syslog;                                                                                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">oam ethernet link-fault-management action-profile action</a> ]                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 8.5.                                                                                                     |
| <b>Description</b>              | Generate a syslog message for the Ethernet Operation, Administration, and Management (OAM) event.                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Specifying the Actions to Be Taken for Link-Fault Management Events on page 605</a></li></ul> |



---

## system-id

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>system-id <i>system-id</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces aeX aggregated-ether-options lacp]                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 12.2R1                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>Define the LACP system identifier at the aggregated Ethernet interface level.</p> <p>The user-defined system identifier in LACP enables two ports from two separate routers (M Series or MX Series routers) to act as though they were part of the same aggregate group.</p> <p>The system identifier is a 48-bit (6-byte) globally unique field. It is used in combination with a 16-bit system-priority value, which results in a unique LACP system identifier.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LACP for Aggregated Ethernet Interfaces on page 148</a></li></ul>                                                                                                                                                                                                                                                                                                                                         |

## system-priority

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>system-priority <i>priority</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Hierarchy Level</b>          | [edit interfaces aeX aggregated-ether-options lACP]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.<br>Statement introduced in Junos OS Release 11.4 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>Define LACP system priority at the aggregated Ethernet interface level. This system priority value takes precedence over a system priority value configured at the global [edit chassis] hierarchy level.</p> <p>The device with the lower system priority value determines which links between LACP partner devices are active and which are in standby for each LACP group. The device on the controlling end of the link uses port priorities to determine which ports are bundled into the aggregated bundle and which ports are put in standby mode. Port priorities on the other device (the noncontrolling end of the link) are ignored. In priority comparisons, numerically lower values have higher priority. Therefore, the system with the numerically lower value (higher priority value) for LACP system priority becomes the controlling system. If both devices have the same LACP system priority (for example, they are both configured with the default setting of 127), the device MAC address determines which switch is in control.</p> |
| <b>Options</b>                  | <p><b>priority</b>—Priority for the aggregated Ethernet system. A smaller value indicates a higher priority.</p> <p><b>Range:</b> 0 through 65535</p> <p><b>Default:</b> 127</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## tag-protocol-id (TPIDs Expected to Be Sent or Received)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>tag-protocol-id [<i>tpids</i>];</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | <p>[edit interfaces <i>interface-name</i> <b>gigether-options</b> <b>ethernet-switch-profile</b>],</p> <p>[edit interfaces <i>interface-name</i> <b>aggregated-ether-options</b> <b>ethernet-switch-profile</b>],</p> <p>[edit interfaces <i>interface-name</i> <b>aggregated-ether-options</b> <b>ethernet-switch-profile</b>],</p> <p>[edit interfaces <i>interface-name</i> <b>ether-options</b> <b>ethernet-switch-profile</b>]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.</p> <p>Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 14.1X53-D15 for the QFX Series.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, aggregated Ethernet with Gigabit Ethernet IQ interfaces, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC, and the built-in Gigabit Ethernet port on the M7i router), define the TPIDs expected to be sent or received on a particular VLAN. For each Gigabit Ethernet port, you can configure up to eight TPIDs using the <b>tag-protocol-id</b> statement; but only the first four TPIDs are supported on IQ2 and IQ2-E interfaces.</p> <p>For 10-Gigabit Ethernet LAN/WAN PIC interfaces on T Series routers only the default TPID value (<b>0x8100</b>) is supported.</p> <p>For Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, and aggregated Ethernet interfaces on EX Series switches, define the TPIDs expected to be sent or received on a particular VLAN. The default TPID value is <b>0x8100</b>. Other supported values are <b>0x88a8</b>, <b>0x9100</b>, and <b>0x9200</b>.</p> |
| <b>Options</b>                  | <i>tpids</i> —TPIDs to be accepted on the VLAN. Specify TPIDs in hexadecimal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames on page 487</a></li> <li>• <a href="#">Configuring Q-in-Q Tunneling (CLI Procedure)</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## tag-protocol-id (TPID to Rewrite)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>tag-protocol-id <i>tpid</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</code><br><code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code>  <a href="#">input-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code>  <a href="#">output-vlan-map</a>]</code> |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces only, configure the outer TPID value. All TPIDs you include in input and output VLAN maps must be among those you specify at the <code>[edit interfaces <i>interface-name</i> <a href="#">gigether-options ethernet-switch-profile tag-protocol-id [ <i>tpids</i> ]]</a></code> hierarchy level.</p> <p>For 10-Gigabit Ethernet LAN/WAN PIC interfaces on T Series routers the default TPID value (<b>0x8100</b>) is supported.</p>                                                                                                         |
| <b>Default</b>                  | If the <code>tag-protocol-id</code> statement is not configured, the TPID value is 0x8100.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring Inner and Outer TPIDs and VLAN IDs on page 490</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## tca

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>tca tca-identifier (enable-tca   no-enable-tca) (threshold <i>number</i>   threshold-24hrs <i>number</i>)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>     | <p>[edit interfaces <i>interface-name</i> optics-options]</p> <p>[edit interfaces <i>interface-name</i> otn-options]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b> | Statement introduced in Junos OS Release 14.2 on the PTX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>         | <p>TCAs can give the management system an early indication as to the state of the associated entity when it crosses a certain threshold. TCAs can be set for both minimum and maximum values for gauges and only maximum values for counters. The timely detection of TCAs is essential to proactively manage the interface. TCAs are not an indication of a fault, but rather an indication that the entity may be close to a fault. You can choose which TCAs you want monitored by enabling the TCA. You can either keep the default threshold settings or change the settings.</p> <p>Enable threshold crossing alerts (TCAs) for the following:</p> <ul style="list-style-type: none"> <li>• Optical channel data unit (ODU)</li> <li>• Optical channel transport unit (OTU)</li> <li>• Laser power</li> <li>• Laser temperature</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Default</b>             | By default, TCAs are not enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>             | <p><i>tca-identifier</i> —At the otn-options hierarchy level, it can be one of the following:</p> <ul style="list-style-type: none"> <li>• <b>odu-tca-bbe</b>—ODU background block error threshold-crossing defect trigger</li> <li>• <b>odu-tca-bbe-fe</b>—ODU far-end background block error threshold-crossing defect trigger</li> <li>• <b>odu-tca-es</b>—ODU errored seconds threshold-crossing defect trigger</li> <li>• <b>odu-tca-es-fe</b>—ODU far-end errored seconds threshold-crossing defect trigger</li> <li>• <b>odu-tca-ses</b>—ODU severely errored seconds threshold-crossing defect trigger</li> <li>• <b>odu-tca-ses-fe</b>—ODU far-end severely errored seconds threshold-crossing defect trigger</li> <li>• <b>odu-tca-uas</b>—ODU unavailable seconds threshold-crossing defect trigger</li> <li>• <b>odu-tca-uas-fe</b>—ODU far-end unavailable seconds threshold-crossing defect trigger</li> <li>• <b>otu-tca-bbe</b>—OTU background block error threshold-crossing defect trigger</li> <li>• <b>otu-tca-bbe-fe</b>—OTU far-end background block error threshold-crossing defect trigger</li> <li>• <b>otu-tca-es</b>—OTU errored seconds threshold-crossing defect trigger</li> <li>• <b>otu-tca-es-fe</b>—OTU far-end errored seconds threshold-crossing defect trigger</li> </ul> |

- **otu-tca-fec-ber**—OTU errored seconds threshold-crossing defect trigger
- **otu-tca-ses**—OTU severely errored seconds threshold-crossing defect trigger
- **otu-tca-ses-fe**—OTU far-end severely errored seconds threshold-crossing defect trigger
- **otu-tca-uas**—OTU unavailable seconds threshold-crossing defect trigger
- **otu-tca-uas-fe**—OTU far-end unavailable seconds threshold-crossing defect trigger

*tca-identifier* —At the optics-options hierarchy level, it can be one of the following:

- **carrier-frequency-offset-high-tca**—Carrier frequency high threshold setting trigger
- **carrier-frequency-offset-low-tca**—Carrier frequency low threshold setting trigger
- **rx-power-high-tca**—Rx power high threshold setting trigger
- **rx-power-low-tca**—Rx power low threshold setting trigger
- **temperature-high-tca**—Temperature high threshold setting trigger
- **temperature-low-tca**—Temperature low threshold setting trigger
- **tx-power-high-tca**—Tx power high threshold setting trigger
- **tx-power-low-tca**—Tx power low threshold setting trigger

**enable-tca** | **no-enable-tca**—To enable or disable the threshold crossing alert.

**threshold** | **threshold-24hrs**:

- **threshold *number***—Set the 15-minute interval threshold.
- **threshold-24hrs *number***—Set the 24-hour interval threshold.

|                                 |                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | <b>interface</b> —To view this statement in the configuration.                        |
|                                 | <b>interface-control</b> —To add this statement to the configuration.                 |
| <b>Related Documentation</b>    | • <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a> |
|                                 | • <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a>                   |
|                                 | • <a href="#">optics-options on page 1097</a>                                         |

## terminate (PPPoE Service Name Tables)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | terminate;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Hierarchy Level</b>          | [edit protocols pppoe service-name-tables <i>table-name</i> <b>service</b> <i>service-name</i> ],<br>[edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b><br>aci <i>circuit-id-string</i> ari <i>remote-id-string</i> ]                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Support at [edit protocols pppoe service-name-tables <i>table-name</i> service <i>service-name</i> <b>agent-specifier</b> aci <i>circuit-id-string</i> ari <i>remote-id-string</i> ] hierarchy level introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Direct the router to immediately respond to a PPPoE Active Discovery Initiation (PADI) control packet received from a PPPoE client by sending the client a PPPoE Active Discovery Offer (PADO) packet. The PADO packet contains the name of the access concentrator (router) that can service the client request. The <b>terminate</b> action is the default action for a named service entry, <b>empty</b> service entry, <b>any</b> service entry, or agent circuit identifier/agent remote identifier (ACI/ARI) pair in a PPPoE service name table. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring PPPoE Service Name Tables</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## traceoptions

---

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>traceoptions {<br/>    file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>maximum-file-size</i>&gt; &lt;world-readable  <br/>        no-world-readable&gt;;<br/>    flag <i>flag</i> &lt;disable&gt;;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>     | [edit protocols <b>lldp</b> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <b>lldp</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>         | Set LLDP protocol-level tracing options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Default</b>             | The default LLDP protocol-level trace options are inherited from the global <b>traceoptions</b> statement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>             | <p><b>disable</b>—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as <b>all</b>.</p> <p><b>file <i>filename</i></b>—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place spanning-tree protocol tracing output in the file <b>/var/log/stp-log</b>.</p> <p><b>files <i>number</i></b>—(Optional) Maximum number of trace files. When a trace file named <b>trace-file</b> reaches its maximum size, it is renamed <b>trace-file.0</b>, then <b>trace-file.1</b>, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.</p> <p>If you specify a maximum number of files, you must also specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000 files</p> <p><b>Default:</b> 1 trace file only</p> <p><b>flag</b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements. The following are the LLDP-specific tracing options:</p> <ul style="list-style-type: none"><li>• <b>all</b>—Trace all operations.</li><li>• <b>config</b>—Log configuration events.</li><li>• <b>interface</b>—Trace interface update events.</li><li>• <b>protocol</b>—Trace protocol information.</li><li>• <b>rtsock</b>—Trace socket events.</li><li>• <b>vlan</b>—Trace vlan update events.</li></ul> |



The following are the global tracing options:

- **all**—All tracing operations.
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events. This is the default. If you do not specify this option, only unusual or abnormal operations are traced.
- **parse**—Trace configuration parsing.
- **policy**—Trace policy operations and actions.
- **regex-parse**—Trace regular-expression parsing.
- **route**—Trace routing table changes.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

**no-world-readable**—(Optional) Prevent any user from reading the log file. This is the default. If you do not include this option, tracing output is appended to an existing trace file.

**size maximum-file-size**—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named **trace-file** reaches this size, it is renamed **trace-file.0**. When the **trace-file** again reaches its maximum size, **trace-file.0** is renamed **trace-file.1** and **trace-file** is renamed **trace-file.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

**Syntax:** **xk** to specify KB, **xm** to specify MB, or **xg** to specify GB

**Range:** 10 KB through the maximum file size supported on your system

**Default:** 1 MB

**world-readable**—(Optional) Allow any user to read the log file.

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Tracing LLDP Operations on page 320</a></li> </ul>             |

## traceoptions (Ethernet Ring Protection)

---

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>traceoptions {<br/>    file <i>filename</i> &lt;no-stamp&gt; &lt;world-readable   no-world-readable&gt; &lt;replace&gt; &lt;size <i>size</i>&gt;;<br/>    flag <i>flag</i>;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>     | [edit protocols <a href="#">protection-group</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>         | Configure trace options for the protection group.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Default</b>             | Trace options are not set by default. On some EX Series switches, logging of basic ERPS state transitions is set by default. You can configure trace options on those switches to obtain more details than are provided by the default log. See <a href="#">“Understanding Ethernet Ring Protection Switching Functionality” on page 214</a> for additional information about default logging of the basic state transitions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>             | <p><b>file <i>filename</i></b>—Name of the file to receive the output of the tracing operation. All files are placed in the directory <b>/var/log</b>. You can include the following file options:</p> <ul style="list-style-type: none"><li>• <b>no-stamp</b>—(Optional) Do not timestamp trace file.</li><li>• <b>no-world-readable</b>—(Optional) Do not allow any user to read the log file.</li><li>• <b>replace</b>—(Optional) Replace the trace file rather than appending to it.</li><li>• <b>size</b>—(Optional) Maximum trace file size (10240..4294967295).</li><li>• <b>world-readable</b>—(Optional) Allow any user to read the log file.</li></ul> <p><b>flag <i>flag</i></b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements. The following flags are available for both EX Switches and MX Series routers:</p> <ul style="list-style-type: none"><li>• <b>all</b>—Trace all</li><li>• <b>config</b> —Trace configuration messages</li><li>• <b>debug</b>—Trace debug messages</li><li>• <b>events</b>—Trace events to the protocol state machine</li><li>• <b>normal</b>—Trace normal messages</li><li>• <b>pdu</b> —Trace RAPS PDU reception and transmission</li><li>• <b>periodic-packet-management</b>—Trace periodic packet management state and events</li><li>• <b>state-machine</b>—Trace RAPS state machine</li><li>• <b>timers</b>—Trace protocol timers</li></ul> |

|                                 |                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | system—To view this statement in the configuration.<br>system-control—To add this statement to the configuration.                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring Ethernet Ring Protection Switching (CLI Procedure)</i></li><li>• <i>Example: Configuring Ethernet Ring Protection Switching on EX Series Switches</i></li><li>• <i>Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS</i></li></ul> |

## traceoptions (Interface Process)

---

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre>traceoptions {<br/>    file &lt;filename&gt; &lt;files number&gt; &lt;match regular-expression&gt; &lt;size size&gt; &lt;world-readable  <br/>        no-world-readable&gt;;<br/>    flag flag &lt;disable&gt;;<br/>    no-remote-trace;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hierarchy Level</b>     | [edit interfaces]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 9.0 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>         | Define tracing operations for the interface process (dcd).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Default</b>             | If you do not include this statement, no interface-specific tracing operations are performed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>             | <p><b>disable</b>—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as <b>all</b>.</p> <p><b>filename</b>—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory <b>/var/log</b>. By default, interface process tracing output is placed in the file <b>dcd</b>.</p> <p><b>files number</b>—(Optional) Maximum number of trace files. When a trace file named <b>trace-file</b> reaches its maximum size, it is renamed <b>trace-file.0</b>, then <b>trace-file.1</b>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p>If you specify a maximum number of files, you also must specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 3 files</p> <p><b>flag</b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements. You can include the following flags:</p> <ul style="list-style-type: none"><li>• <b>all</b></li><li>• <b>change-events</b>—Log changes that produce configuration events</li><li>• <b>config-states</b>—Log the configuration state machine changes</li><li>• <b>kernel</b>—Log configuration IPC messages to kernel</li><li>• <b>kernel-detail</b>—Log details of configuration messages to kernel</li></ul> <p><b>no-world-readable</b>—(Optional) Disallow any user to read the log file.</p> |

**size size**—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches this size, it is renamed **trace-file.0**. When the **trace-file** again reaches its maximum size, **trace-file.0** is renamed **trace-file.1** and **trace-file** is renamed **trace-file.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

**Syntax:** **xk** to specify kilobytes, **xm** to specify megabytes, or **xg** to specify gigabytes

**Range:** 10 KB through the maximum file size supported on your router

**Default:** 1 MB

**world-readable**—(Optional) Allow any user to read the log file.

**match regex**—(Optional) Refine the output to include only those lines that match the given regular expression.

|                                 |                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.                                               |
|                                 | interface-control—To add this statement to the configuration.                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Tracing Operations of the Interface Process</i></li></ul> |

## traceoptions (LACP)

---

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax              | <pre>traceoptions {<br/>    file &lt;filename&gt; &lt;files number&gt; &lt;size size&gt; &lt;world-readable   no-world-readable&gt;;<br/>    flag flag;<br/>    no-remote-trace;<br/>}</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Hierarchy Level     | [edit protocols lacp]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Release Information | Statement introduced in Junos OS Release 7.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description         | Define tracing operations for the LACP protocol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Default             | If you do not include this statement, no LACP protocol tracing operations are performed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Options             | <p><b>filename</b>—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory <b>/var/log</b>. By default, interface process tracing output is placed in the file <b>lacpd</b>.</p> <p><b>files number</b>—(Optional) Maximum number of trace files. When a trace file named <b>trace-file</b> reaches its maximum size, it is renamed <b>trace-file.0</b>, then <b>trace-file.1</b>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</p> <p>If you specify a maximum number of files, you also must specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 3 files</p> <p><b>flag</b>—Tracing operation to perform. To specify more than one tracing operation, include multiple <b>flag</b> statements. You can include the following flags:</p> <ul style="list-style-type: none"><li>• <b>all</b>—All LACP tracing operations</li><li>• <b>configuration</b>—Configuration code</li><li>• <b>packet</b>—Packets sent and received</li><li>• <b>process</b>—LACP process events</li><li>• <b>protocol</b>—LACP protocol state machine</li><li>• <b>routing-socket</b>—Routing socket events</li><li>• <b>startup</b>—Process startup events</li></ul> <p><b>no-world-readable</b>—(Optional) Prevent any user from reading the log file.</p> <p><b>size size</b>—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named <b>trace-file</b> reaches this size, it is renamed <b>trace-file.0</b>. When the <b>trace-file</b> again reaches its maximum size, <b>trace-file.0</b> is renamed <b>trace-file.1</b> and <b>trace-file</b> is renamed <b>trace-file.0</b>. This renaming scheme continues</p> |

until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option:

**Syntax:** **xk** to specify kilobytes, **xm** to specify megabytes, or **xg** to specify gigabytes


**Range:** 10 KB through the maximum file size supported on your router

**Default:** 1 MB

**world-readable**—(Optional) Allow any user to read the log file.

|                                 |                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.                                                |
|                                 | interface-control—To add this statement to the configuration.                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Tracing LACP Operations on page 148</a></li></ul> |

## traceoptions (PPPoE)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre> traceoptions {     file &lt;filename&gt; &lt;files number&gt; &lt;match regular-expression&gt; &lt;size maximum-file-size&gt;     &lt;world-readable   no-world-readable&gt;;     filter {         aci regular-expression;         ari regular-expression;         service-name regular-expresion;         underlying-interface interface-name;     }     flag flag;     level (all   error   info   notice   verbose   warning);     no-remote-trace; } </pre>                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>     | [edit protocols pppoe]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.6.<br>Option <b>filter</b> introduced in Junos OS Release 12.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>         | Define tracing operations for PPPoE processes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>             | <p><b>file filename</b>—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory <b>/var/log</b>.</p> <p><b>files number</b>—(Optional) Maximum number of trace files to create before overwriting the oldest one. If you specify a maximum number of files, you also must specify a maximum file size with the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 3 files</p> <p><b>disable</b>—Disable this trace flag.</p> <p><b>filter</b>—Additional filter to refine the output to display particular subscribers. Filtering based on the following subscriber identifiers simplifies troubleshooting in a scaled environment.</p> |
|                            | <p> <b>BEST PRACTICE:</b> Due to the complexity of agent circuit identifiers and agent remote identifiers, we recommend that you do not try an exact match when filtering on these options. For service names, searching on the exact name is appropriate, but you can also use a regular expression with that option.</p>                                                                                                                                                                                                                                                                                                                                               |
|                            | <ul style="list-style-type: none"> <li>• <b>aci regular-expression</b>—Regular expression to match the agent circuit identifier provided by PPPoE client.</li> <li>• <b>ari regular-expression</b>—Regular expression to match the agent remote identifier provided by PPPoE client.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



- **service *regular-expression***—Regular expression to match the name of PPPoE service.
- **underlying-interface *interface-name***—Name of a PPPoE underlying interface. You cannot use a regular expression for this filter option.

**flag *flag***—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. You can include the following flags:

- **all**—Trace all operations.
- **config**—Trace configuration events.
- **events**—Trace events.
- **gres**—Trace GRES events.
- **init**—Trace initialization events.
- **interface-db**—Trace interface database operations.
- **memory**—Trace memory processing events.
- **protocol**—Trace protocol events.
- **rtsock**—Trace routing socket events.
- **session-db**—Trace connection events and flow.
- **signal**—Trace signal operations.
- **state**—Trace state handling events.
- **timer**—Trace timer processing.
- **ui**—Trace user interface processing.

**level**—Level of tracing to perform. You can specify any of the following levels:

- **all**—Match all levels.
- **error**—Match error conditions.
- **info**—Match informational messages.
- **notice**—Match notice messages about conditions requiring special handling.
- **verbose**—Match verbose messages.
- **warning**—Match warning messages.

**Default:** error

**match *regular-expression***—(Optional) Refine the output to include lines that contain the regular expression.

**no-remote-trace**—Disable remote tracing.

**no-world-readable**—(Optional) Disable unrestricted file access.

**size** *maximum-file-size*—(Optional) Maximum size of each trace file. By default, the number entered is treated as bytes. Alternatively, you can include a suffix to the number to indicate kilobytes (KB), megabytes (MB), or gigabytes (GB). If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

**Syntax:** *sizek* to specify KB, *sizem* to specify MB, or *sizeg* to specify GB

**Range:** 10240 through 1073741824

**Default:** 128 KB

**world-readable**—(Optional) Enable unrestricted file access.

|                                 |                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | trace—To view this statement in the configuration.<br>trace-control—To add this statement to the configuration. |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------|

|                              |                                                                                                                                                                        |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <a href="#">Configuring PPPoE Service Name Tables</a></li><li>• <a href="#">Tracing PPPoE Operations on page 338</a></li></ul> |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## traceoptions (802.1X and Captive Portal for MX Series in Enhanced LAN Mode)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <pre> traceoptions {     file <i>filename</i> &lt;files <i>number</i>&gt; &lt;size <i>size</i>&gt; &lt;world-readable   no-world-readable&gt; &lt;match         <i>regex</i>&gt;;     flag <i>flag</i>; } </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>     | [edit protocols authentication-access-control]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b> | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>         | Define tracing operations for the 802.1X protocol, LLDP, and captive portal authentication.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Default</b>             | Tracing operations are disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>             | <p><b>file <i>filename</i></b>—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory <code>/var/log</code>.</p> <p><b>files <i>number</i></b>—(Optional) Maximum number of trace files. When a trace file named <b>trace-file</b> reaches its maximum size, it is renamed <b>trace-file.0</b>, then <b>trace-file.1</b>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size by using the <b>size</b> option.</p> <p><b>Range:</b> 2 through 1000</p> <p><b>Default:</b> 3 files</p> <p><b>flag <i>flag</i></b>—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:</p> <ul style="list-style-type: none"> <li>• <b>all</b>—All tracing operations.</li> <li>• <b>config-internal</b>—Trace internal configuration operations.</li> <li>• <b>dot1x-event</b>—Trace 802.1x events.</li> <li>• <b>dot1x-debug</b>—Trace 802.1x events.</li> <li>• <b>dot1x-ipc</b>—Trace IPC interactions.</li> <li>• <b>eapol</b>—Trace EAPOL packets transmitted and received.</li> <li>• <b>general</b>—Trace general operations.</li> <li>• <b>normal</b>—Trace normal operations.</li> <li>• <b>parse</b>—Trace reading of the configuration.</li> <li>• <b>regex-parse</b>—Trace regular-expression parsing operations.</li> <li>• <b>state</b>—Trace protocol state changes.</li> <li>• <b>task</b>—Trace protocol task operations.</li> </ul> |

- **timer**—Trace protocol timer operations.
- **vlan**—Trace VLAN transactions.

**match *regex***—(Optional) Refine the output to include lines that contain the regular expression.

**no-world-readable**—(Optional) Restrict file access to the user who created the file.

**size *size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files with the **files** option, you also must specify a maximum file size.

**Syntax:** **xk** to specify KB, **xm** to specify MB, or **xg** to specify GB

**Range:** 10 KB through 1 GB

**Default:** 128 KB

**world-readable**—(Optional) Enable unrestricted file access.

|                                 |                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration. |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|

---

## transmit-delay

---

|                                 |                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | transmit-delay <i>seconds</i> ;                                                                                                  |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">lldp</a> ],<br>[edit routing-instances <i>routing-instance-name</i> protocols <a href="#">lldp</a> ] |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                    |
| <b>Description</b>              | (MX Series and T Series routers only) Configure a delay between two successive LLDP advertisements.                              |
| <b>Options</b>                  | <b><i>seconds</i></b> —Delay between two successive LLDP advertisements.<br><b>Default:</b> 2<br><b>Range:</b> 1 through 8192    |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring LLDP on page 316</a></li></ul>                                   |

## transmit-interval (MACsec for MX Series)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>transmit-interval <i>interval</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>          | <code>[edit security macsec connectivity-association <i>connectivity-association-name</i> mka]</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p>Specifies the transmit interval for MACsec Key Agreement (MKA) protocol data units (PDUs).</p> <p>The MKA transmit interval setting sets the frequency for how often the MKA PDU is sent to the directly connected device to maintain MACsec on a point-to-point Ethernet link. A lower <i>interval</i> increases bandwidth overhead on the link; a higher <i>interval</i> optimizes the MKA protocol data unit exchange process.</p> <p>The transmit interval settings must be identical on both ends of the link when MACsec using static connectivity association key (CAK) security mode is enabled.</p> <p>We recommend increasing the interval to 6000 ms in high-traffic load environments.</p> |
| <b>Default</b>                  | The default transmit interval is 2000 milliseconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | <i>interval</i> —Specifies the transmit interval, in milliseconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Privilege Level</b> | <p>admin—To view this statement in the configuration.</p> <p>admin-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Media Access Control Security (MACsec) on MX Series Routers on page 93</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## transmit-period

---

|                                 |                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>transmit-period seconds;</code>                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | <code>[edit protocols dot1x authenticator interface <i>interface-id</i>]</code>                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.3.                                                                                                                                                                                                                                                      |
| <b>Description</b>              | Set the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.                                                                                                                                                                                               |
| <b>Options</b>                  | <b>seconds</b> —The number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.<br><b>Range:</b> 1 through 65,535 seconds<br><b>Default:</b> 30 seconds                                                                                                           |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">IEEE 802.1x Port-Based Network Access Control Overview on page 33</a></li><li>• <a href="#">authenticator on page 881</a></li><li>• <a href="#">dot1x on page 931</a></li><li>• <a href="#">interface (IEEE 802.1x) on page 1004</a></li></ul> |

## transmit-period (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>transmit-period seconds;</code>                                                                                                                                                    |
| <b>Hierarchy Level</b>          | <code>[edit protocols authentication-access-control interface (all   [<i>interface-names</i>]) dot1x]</code>                                                                             |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                  |
| <b>Description</b>              | For 802.1X authentication, how long the port waits before retransmitting the initial EAPOL PDUs to the supplicant.                                                                       |
| <b>Default</b>                  | 30 seconds                                                                                                                                                                               |
| <b>Options</b>                  | <b>seconds</b> —Number of seconds the port waits before retransmitting the initial EAPOL PDUs to the supplicant.<br><b>Range:</b> 1 through 65,535 seconds<br><b>Default:</b> 30 seconds |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                      |

## transport-monitoring

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | transport-monitoring;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Hierarchy Level</b>          | [edit interfaces]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for PTX5000 and PTX3000 routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | <p>Monitor the performance and state of packet transport for OTN and optics modules. The following statistics are monitored:</p> <ul style="list-style-type: none"> <li>• Packet transport for ninety-six 15-minute intervals for the current 24 hours.</li> <li>• Cumulative data of the current 24 hours.</li> <li>• Cumulative data of the previous 24 hours.</li> </ul> <p>If this statement is configured, transport monitoring related information is shown in the output of <b>show interface transport</b> command and corresponding MIBs are available. If this option is disabled, an error is shown in the output and corresponding MIBs are not available.</p> |
| <b>Required Privilege Level</b> | <p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show interfaces transport pm on page 1683</a></li> <li>• <i>Managed Objects for the OTN Interface</i></li> <li>• <i>Managed Objects for the Optics Interface</i></li> <li>• <i>Optical Parameters Associated with Black Link End Points</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                |

## trigger

---

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>trigger trigger-identifier (hold-time hold-time-value   ignore);</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>otn-options</b> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>         | Specify defect triggers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Default</b>             | By default, triggers are ignored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>             | <p><i>trigger-identifier</i>—(For M Series, MX Series, SRX Series, and T Series routers only) Trigger identifier. It can be one of the following:</p> <ul style="list-style-type: none"><li>• <b>oc-lof</b>—Optical channel Loss of Frame defect trigger.</li><li>• <b>oc-lom</b>—Optical channel Loss of Multiframe defect trigger.</li><li>• <b>oc-los</b>—Optical channel Loss of Signal defect trigger.</li><li>• <b>oc-wavelength-lock</b>—Optical channel Wavelength Lock defect trigger.</li><li>• <b>odu-ais</b>—Optical channel data unit (ODU) Alarm Indication Signal defect trigger.</li><li>• <b>odu-bbe-th</b>—ODU Background Block Error Threshold defect trigger.</li><li>• <b>odu-bdi</b>—ODU Backward Defect Indication defect trigger.</li><li>• <b>odu-bei</b>—(MX Series routers only) ODU Backward Error Indication defect trigger.</li><li>• <b>odu-es-th</b>—ODU Errored Seconds Threshold defect trigger.</li><li>• <b>odu-iae</b>—(MX Series routers only) ODU Incoming Alignment Error defect trigger.</li><li>• <b>odu-lck</b>—ODU Locked defect trigger.</li><li>• <b>odu-oci</b>—ODU Open Connection Indication defect trigger.</li><li>• <b>odu-sd</b>—ODU Signal Degrade defect trigger.</li><li>• <b>odu-ses-th</b>—ODU Severely Errored Seconds Threshold defect trigger.</li><li>• <b>odu-tca-es</b>—(MX Series routers only) ODU Errored Seconds Threshold crossing defect trigger.</li><li>• <b>odu-tca-ses</b>—(MX Series routers only) ODU Severely Errored Seconds Threshold crossing defect trigger.</li><li>• <b>odu-tca-uas</b>—(MX Series routers only) ODU Unavailable Seconds Threshold crossing defect trigger.</li><li>• <b>odu-ttim</b>—ODU Trail Trace Identifier Mismatch defect trigger.</li><li>• <b>opu-ptim</b>—(MX Series routers only) Payload Type Identifier Mismatch defect trigger.</li><li>• <b>odu-uas-th</b>—ODU Unavailable Seconds Threshold defect trigger.</li></ul> |



- **opu-ptm**—Optical Channel Payload (OPU) Payload Type Mismatch defect trigger.
- **otu-ais**—Optical Channel Transport Unit (OTU) Alarm Indication Signal defect trigger.
- **otu-bbe-th**—OTU Background Block Error Threshold defect trigger.
- **otu-bdi**—OTU Backward Defect Indication defect trigger.
- **otu-es-th**—OTU Errored Seconds Threshold defect trigger.
- **otu-fec-deg**—OTU FEC Degrade defect trigger.
- **otu-fec-exe**—OTU FEC Excessive Error defect trigger.
- **otu-iae**—OTU Incoming Alignment defect trigger.
- **otu-sd**—OTU Signal Degrade defect trigger.
- **otu-ses-th**—OTU Severely Errored Seconds Threshold defect trigger.
- **otu-tca-es**—(MX Series routers only) OTU Errored Seconds Threshold crossing defect trigger.
- **otu-tca-ses**—(MX Series routers only) OTU Severely Errored Seconds Threshold crossing defect trigger.
- **otu-tca-uas**—(MX Series routers only) OTU Unavailable Seconds Threshold crossing defect trigger.
- **otu-ttim**—OTU Trail Trace Identifier Mismatch defect trigger.
- **otu-uas-th**—OTU Unavailable Seconds Threshold defect trigger.

*trigger-identifier*—(For PTX Series routers only) Trigger identifier. It can be one of the following:

- **oc-lof**—Optical channel Loss of Frame defect trigger.
- **oc-lom**—Optical channel Loss of Multiframe defect trigger.
- **oc-los**—Optical channel Loss of Signal defect trigger.
- **oc-tsf**—Optical channel TOE security functionality (TSF) defect trigger.
- **oc-wavelength-lock**—Optical channel Wavelength Lock defect trigger.
- **odu-ais**—ODU Alarm Indication Signal defect trigger.
- **odu-bdi**—ODU Backward Defect Indication defect trigger.
- **odu-bei**—ODU Backward Error Indication defect trigger.
- **odu-iae**—ODU IAE defect trigger.
- **odu-lck**—ODU Locked defect trigger.
- **odu-oci**—ODU Open Connection Indication defect trigger.
- **odu-sd**—ODU Signal Degrade defect trigger.
- **odu-tca-bbe**—ODU Background Block Error Threshold crossing defect trigger.
- **odu-tca-bbe-fe**—ODU far-end Background Block Error (BEI) Threshold crossing defect trigger.
- **odu-tca-es**—ODU Errored Seconds Threshold crossing defect trigger.
- **odu-tca-es-fe**—ODU far-end Errored Seconds Threshold crossing defect trigger.
- **odu-tca-ses**—ODU Severely Errored Seconds Threshold crossing defect trigger.
- **odu-tca-ses-fe**—ODU far-end Severely Errored Seconds Threshold crossing defect trigger.
- **odu-tca-uas**—ODU Unavailable Seconds Threshold crossing defect trigger.
- **odu-tca-uas-fe**—ODU far-end Unavailable Seconds Threshold crossing defect trigger.
- **odu-ttim**—ODU Trail Trace Identifier Mismatch defect trigger.
- **opu-ptim**—Payload Type Identifier Mismatch defect trigger.
- **otu-ais**—OTU Alarm Indication Signal defect trigger.
- **otu-bdi**—OTU Backward Defect Indication defect trigger.
- **otu-fec-deg**—OTU FEC Degrade defect trigger.
- **otu-fec-exe**—OTU FEC Excessive Error defect trigger.
- **otu-iae**—OTU Incoming Alignment defect trigger.
- **otu-sd**—OTU Signal Degrade defect trigger.
- **otu-tca-bbe**—OTU Background Block Error Threshold crossing defect trigger.
- **otu-tca-bbe-fe**—OTU far-end Background Block Error (BEI) Threshold crossing defect trigger.
- **otu-tca-es**—OTU Errored Seconds Threshold crossing defect trigger.

- **otu-tca-es-fe**—OTU far-end Errored Seconds Threshold crossing defect trigger.
- **otu-tca-ses**—OTU Severely Errored Seconds Threshold crossing defect trigger.
- **otu-tca-ses-fe**—OTU far-end Severely Errored Seconds Threshold crossing defect trigger.
- **otu-tca-uas**—OTU Unavailable Seconds Threshold crossing defect trigger.
- **otu-tca-uas-fe**—OTU far-end Unavailable Seconds Threshold crossing defect trigger.
- **otu-ttim**—OTU Trail Trace Identifier Mismatch defect trigger.

hold-time *hold-time-value*—Hold time value. It can be one of the following:

- **down**—Delay before marking interface down when defect occurs (1.65534 milliseconds).
- **up**—Delay before marking interface up when defect is absent (1.65534 milliseconds).



**NOTE:** The trigger hold time value alone does not mark an interface to be up when the defect is absent or mark an interface to be down when the defect occurs. The hold time value only impacts the alarm reporting time. To mark an interface up or down, you must also configure the physical interface hold time at the [edit interfaces *interface-name* hierarchy level].

---

|                                 |                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.                                |
|                                 | interface-control—To add this statement to the configuration.                         |
| <b>Related Documentation</b>    | • <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a>  |
|                                 | • <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a> |
|                                 | • <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a>                   |

## tti

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>tti <i>tti-identifier</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <a href="#">otn-options</a> ]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers.<br>Statement introduced in Junos OS Release 13.3 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Specify trace identifier options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <p><i>tti-identifier</i>—Trace identifier. It can be one of the following:</p> <ul style="list-style-type: none"> <li>• <b>odu-dapi</b>—Optical Channel Data Unit (ODU) Destination Access Point Identifier.</li> <li>• <b>odu-expected-receive-dapi</b>—ODU Expected Receive Destination Access Point Identifier.</li> <li>• <b>odu-expected-receive-sapi</b>—ODU Expected Receive Source Access Point Identifier.</li> <li>• <b>odu-sapi</b>—ODU Source Access Point Identifier.</li> <li>• <b>otu-dapi</b>—Optical Channel Transport Unit (OTU) Destination Access Point Identifier.</li> <li>• <b>otu-expected-receive-dapi</b>—OTU Expected Receive Destination Access Point Identifier.</li> <li>• <b>otu-expected-receive-sapi</b>—OTU Expected Receive Source Access Point Identifier.</li> <li>• <b>otu-sapi</b>—OTU Source Access Point Identifier.</li> </ul> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">10-Gigabit Ethernet OTN Options Configuration Overview on page 422</a></li> <li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li> <li>• <a href="#">Configuring 100-Gigabit DWDM OTN PICs on page 435</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## tx-power

---


|                                 |                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | tx-power <i>dbm</i> ;                                                                                                                                                                                                                                                         |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> <b>optics-options</b> ]                                                                                                                                                                                                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                                                                                                         |
| <b>Description</b>              | Transmit laser output power (dBm).                                                                                                                                                                                                                                            |
| <b>Default</b>                  | If you don't specify a value, the default transmit laser output power is –2 dBm.                                                                                                                                                                                              |
| <b>Options</b>                  | <i>dbm</i> —Transmit power value.                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet DWDM Interface Wavelength Overview on page 381</a></li><li>• <a href="#">optics-options on page 1097</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li></ul> |

## uac-policy (MX Series in Enhanced LAN Mode)

---

|                                 |                                                                                                                                                                                                           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | uac-policy;                                                                                                                                                                                               |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                                                                   |
| <b>Description</b>              | Configure Junos Pulse Access Control Service as the access policy to authenticate and authorize users connected to the switch for admission to the network and for access to protected network resources. |
| <b>Default</b>                  | The Access Control Service access policy is disabled.                                                                                                                                                     |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                       |
| <b>Related Documentation</b>    |                                                                                                                                                                                                           |

## underlying-interface

|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                          | <code>underlying-interface <i>interface-name</i>;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>                                                                                                                                                                                                                                                                                                                                 | <p>[edit interfaces pp0 unit <i>logical-unit-number</i> <b>pppoe-options</b>],</p> <p>[edit interfaces demux0 unit <i>logical-unit-number</i> demux-options],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces demux0 unit <i>logical-unit-number</i> demux-options],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces pp0 unit <i>logical-unit-number</i> <b>pppoe-options</b>],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> interfaces demux0 unit <i>logical-unit-number</i> demux-options],</p> <p>[edit logical-systems <i>logical-system-name</i> routing-instances <i>routing-instance-name</i> interfaces pp0 unit <i>logical-unit-number</i> <b>pppoe-options</b>]</p> |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                             | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Support for aggregated Ethernet added in Junos OS Release 9.4.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                     | <p>Configure the interface on which PPP over Ethernet is running.</p> <p>For demux interfaces, configure the underlying interface on which the demultiplexing (demux) interface is running.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                                                                                                                                                                                                                                                                                                                                         | <p><b><i>interface-name</i></b>—Name of the interface on which PPP over Ethernet or demux is running. For example, <b>at-0/0/1.0</b> (ATM VC), <b>fe-1/0/1.0</b> (Fast Ethernet interface), <b>ge-2/0/0.0</b> (Gigabit Ethernet interface), <b>ae1.0</b> (for IP demux on an aggregated Ethernet interface), or <b>ae1</b> (for VLAN demux on an aggregated Ethernet interface).</p>                                                                                                                                                                                                                                                                                                                                                                                           |
| <div style="display: flex; align-items: center;">  <div> <p><b>NOTE:</b> Demux interfaces are currently supported on Gigabit Ethernet, Fast Ethernet, 10-Gigabit Ethernet interfaces, or aggregated Ethernet devices.</p> </div> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                        | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>• <i>Configuring an IP Demultiplexing Interface</i></li> <li>• <i>Configuring a VLAN Demultiplexing Interface</i></li> <li>• <a href="#">Configuring the PPPoE Underlying Interface on page 331</a></li> <li>• <i>Junos OS Interfaces and Routing Configuration Guide</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## unit

```

Syntax  unit logical-unit-number {
        accept-source-mac {
            mac-address mac-address {
                policer {
                    input cos-policer-name;
                    output cos-policer-name;
                }
            }
        }
        accounting-profile name;
        advisory-options {
            downstream-rate rate;
            upstream-rate rate;
        }
        allow-any-vci;
        atm-scheduler-map (map-name | default);
        backup-options {
            interface interface-name;
        }
        bandwidth rate;
        cell-bundle-size cells;
        clear-dont-fragment-bit;
        compression {
            rtp {
                maximum-contexts number <force>;
                f-max-period number;
                queues [queue-numbers];
                port {
                    minimum port-number;
                    maximum port-number;
                }
            }
        }
        compression-device interface-name;
        copy-tos-to-outer-ip-header;
        demux-destination family;
        demux-source family;
        demux-options {
            underlying-interface interface-name;
        }
        description text;
        interface {
            l2tp-interface-id name;
            (dedicated | shared);
        }
        dialer-options {
            activation-delay seconds;
            callback;
            callback-wait-period time;
            deactivation-delay seconds;
            dial-string [dial-string-numbers];
            idle-timeout seconds;

```



```

incoming-map {
  caller caller-id | accept-all;
  initial-route-check seconds;
  load-interval seconds;
  load-threshold percent;
  pool pool-name;
  redial-delay time;
  watch-list {
    [routes];
  }
}
}
disable;
disable-mlppp-inner-ppp-pfc;
dlci dlci-identifier;
drop-timeout milliseconds;
dynamic-call-admission-control {
  activation-priority priority;
  bearer-bandwidth-limit kilobits-per-second;
}
encapsulation type;
epd-threshold cells plp1 cells;
family family-name {
  ... the family subhierarchy appears after the main [edit interfaces interface-name unit
    logical-unit-number] hierarchy ...
}
fragment-threshold bytes;
inner-vlan-id-range start start-id end end-id;
input-vlan-map {
  (pop | pop-pop | pop-swap | push | push-push | swap |
  swap-push | swap-swap);
  inner-tag-protocol-id tpid;
  inner-vlan-id number;
  tag-protocol-id tpid;
  vlan-id number;
}
interleave-fragments;
inverse-arp;
layer2-policer {
  input-policer policer-name;
  input-three-color policer-name;
  output-policer policer-name;
  output-three-color policer-name;
}
link-layer-overhead percent;
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
  up-count cells;
  down-count cells;
}
oam-period (disable | seconds);

```

```
output-vlan-map {
  (pop | pop-pop | pop-swap | push | push-push | swap |
  swap-push | swap-swap);
  inner-tag-protocol-id tpid;
  inner-vlan-id number;
  tag-protocol-id tpid;
  vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
  mtu (size | use-lower-layer);
  mru size;
  chap {
    access-profile name;
    default-chap-secret name;
    local-name name;
    passive;
  }
  compression {
    acfc;
    pfc;
  }
  dynamic-profile profile-name;
  lcp-restart-timer milliseconds;
  loopback-clear-timer seconds;
  ncp-restart-timer milliseconds;
  pap {
    access-profile name;
    default-pap-password password;
    local-name name;
    local-password password;
    passive;
  }
}
pppoe-options {
  access-concentrator name;
  auto-reconnect seconds;
  (client | server);
  service-name name;
  underlying-interface interface-name;
}
pppoe-underlying-options {
  access-concentrator name;
  direct-connect;
  dynamic-profile profile-name;
  max-sessions number;
}
proxy-arp;
service-domain (inside | outside);
shaping {
  (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate burst
  length);
  queue-length number;
```

```

}
short-sequence;
targeted-distribution;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;
    routing-instance {
        destination routing-instance-name;
    }
    source source-address;
    ttl number;
}
vci vpi-identifier.vci-identifier;
vci-range start start-vci end end-vci;
vpi vpi-identifier;
vlan-id number;
vlan-id-range number-number;
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            (input | output | input output);
        }
    }
}
access-concentrator name;
address address {
    ... the address subhierarchy appears after the main [edit interfaces interface-name unit
        logical-unit-number family family-name] hierarchy ...
}
bundle interface-name;
core-facing;
demux-destination {
    destination-prefix;
}
demux-source {
    source-prefix;
}
direct-connect;
duplicate-protection;
dynamic-profile profile-name;
filter {
    group filter-group-number;
    input filter-name;
    input-list [filter-names];
    output filter-name;
    output-list [filter-names];
}
interface-mode (access | trunk);
ipsec-sa sa-name;
keep-address-and-control;

```

```
mac-validate (loose | strict);
max-sessions number;
mtu bytes;
multicast-only;
no-redirects;
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
protocols [inet iso mpls];
proxy inet-address address;
receive-options-packets;
receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check {
    fail-filter filter-name
    mode loose;
}
sampling {
    input;
    output;
}
service {
    input {
        post-service-filter filter-name;
        service-set service-set-name <service-filter filter-name>;
    }
    output {
        service-set service-set-name <service-filter filter-name>;
    }
}
service-name-table table-name
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecrn-and-becn | no-translate-fecrn-and-becn);
translate-plp-control-word-de;
unnumbered-address interface-name destination address
    destination-profile profile-name;
vlan-id number;
vlan-id-list [number number-number];
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    master-only;
    multipoint-destination address {
        dlci dlci-identifier;
        epd-threshold cells <plp1 cells>;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
    }
}
```

```

oam-period (disable | seconds);
shaping {
    (cbr rate | rtvbr burst length peak rate sustained rate | vbr burst length peak rate
    sustained rate);
    queue-length number;
}
vci vpi-identifier.vci-identifier;
}
preferred;
primary;
(vrrp-group | vrrp-inet6-group) group-number {
    (accept-data | no-accept-data);
    advertise-interval seconds;
    authentication-type authentication;
    authentication-key key;
    fast-interval milliseconds;
    (preempt | no-preempt) {
        hold-time seconds;
    }
    priority number;
    track {
        interface interface-name {
            bandwidth-threshold bits-per-second priority-cost number;
        }
        priority-hold-time seconds;
        route ip-address/prefix-length routing-instance instance-name priority-cost cost;
    }
    virtual-address [addresses];
    virtual-link-local-address ipv6-address;
    vrrp-inherit-from {
        active-interface interface-name;
        active-group group-number;
    }
}
}
}
}

```

|                            |                                                                                                                                                                                                                                                                    |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> ],<br>[edit interfaces interface-set <i>interface-set-name</i> interface <i>interface-name</i> ]                                    |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                  |
| <b>Description</b>         | Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.                                                                                                                                |
| <b>Options</b>             | <p><b>logical-unit-number</b>—Number of the logical unit.</p> <p><b>Range:</b> 0 through 1,073,741,823 for demux and PPPoE static interfaces. 0 through 16,385 for all other static interface types.</p> <p>The remaining statements are explained separately.</p> |

|                           |                                                               |
|---------------------------|---------------------------------------------------------------|
| <b>Required Privilege</b> | interface—To view this statement in the configuration.        |
| <b>Level</b>              | interface-control—To add this statement to the configuration. |

---

## unnumbered-address (PPP)

---

|                                 |                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>unnumbered-address interface-name destination address destination-profile profile-name;</code>                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit <a href="#">interfaces</a> <i>interface-name</i> <a href="#">unit</a> <i>logical-unit-number</i> <a href="#">family</a> inet],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">family</a> inet]              |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                   |
| <b>Description</b>              | For interfaces with PPP encapsulation, enable the local address to be derived from the specified interface.                                                                                                                                                                                         |
| <b>Options</b>                  | <i>interface-name</i> —Interface from which the local address is derived. The interface name must include a logical unit number and must have a configured address.<br><br>The remaining statements are explained separately.                                                                       |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <i>Configuring IPCP Options for Interfaces with PPP Encapsulation</i></li><li>• <a href="#">address on page 863</a></li><li>• <a href="#">negotiate-address on page 1078</a></li><li>• <i>Junos OS Administration Library for Routing Devices</i></li></ul> |

## version-3

|                            |                                                               |
|----------------------------|---------------------------------------------------------------|
| <b>Syntax</b>              | version-3;                                                    |
| <b>Hierarchy Level</b>     | [edit protocols vrrp]                                         |
| <b>Release Information</b> | Statement introduced in Junos OS Release 12.2.                |
| <b>Description</b>         | Enable Virtual Router Redundancy Protocol version 3 (VRRPv3). |



### NOTE:

- Even though the version-3 statement can be configured only at the [edit protocols vrrp] hierarchy level, VRRPv3 is enabled on all the configured logical systems as well.
- When enabling VRRPv3, you must ensure that VRRPv3 is enabled on all the VRRP routers in the network. This is because VRRPv3 does not interoperate with the previous versions of VRRP.

|                                 |                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Junos OS Support for VRRPv3</i></li> <li>• <i>VRRP for IPv4 Configuration Hierarchy</i></li> <li>• <i>VRRP for IPv6 Configuration Hierarchy</i></li> </ul> |

## virtual-control-channel

---

|                                 |                                                                                                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>virtual-control-channel <i>channel-name</i> {<br/>    west-interface <i>name</i>;<br/>    east-interface <i>name</i>;<br/>}</code>                                                                           |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring <i>name</i></a> ( <a href="#">east-interface</a>   <a href="#">west-interface</a> )]                                                                    |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                     |
| <b>Description</b>              | Specify virtual control channels which are logical interfaces on the east and west interfaces of the major ring.                                                                                                   |
| <b>Options</b>                  | <b>west-interface <i>name</i></b> —Logical interface on the major ring's west port.<br><br><b>east-interface <i>name</i></b> —Logical interface on the major ring's east port.                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li><li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li></ul> |

## virtual-switch

---

|                                 |                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>virtual-switch <i>name</i> bridge-domain <i>name</i> vlan-id [<i>vlan-ids</i> ];</code>                                        |
| <b>Hierarchy Level</b>          | [edit protocols oam ethernet connectivity-fault-management <a href="#">maintenance-domain <i>domain-name</i></a> default-x]          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.6.                                                                                        |
| <b>Description</b>              | Specify the routing-instance type as a virtual switch, under which bridge-domain MIPs must be enabled.                               |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring MIP for Bridge Domains of a Virtual Switch on page 526</a></li></ul> |



## vlan-assignment

---

|                                 |                                                                                                                                                         |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>vlan-assignment (vlan-id   vlan-name);</code>                                                                                                     |
| <b>Hierarchy Level</b>          | [edit protocols authentication-access-control]                                                                                                          |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.                                                 |
| <b>Description</b>              | Configure the VLAN that is associated with the list of MAC addresses that are excluded from RADIUS authentication.                                      |
| <b>Options</b>                  | <i>vlan-id</i>   <i>vlan-name</i> —The name of the VLAN or the VLAN tag identifier to associate with the device. The VLAN already exists on the switch. |
| <b>Required Privilege Level</b> | routing—To view this statement in the configuration.<br>routing-control—To add this statement to the configuration.                                     |

## vlan-id (VLAN ID to Be Bound to a Logical Interface)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>vlan-id number;</code>                                                                                                                                                                                                                                                                                                                        |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ]                                                                                                                                                    |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | For Fast Ethernet, Gigabit Ethernet, and Aggregated Ethernet interfaces only, bind a 802.1Q VLAN tag ID to a logical interface.                                                                                                                                                                                                                     |
| <b>Options</b>                  | <i>number</i> —A valid VLAN identifier.<br><b>Range:</b> For aggregated Ethernet, 4-port, 8-port, and 12-port Fast Ethernet PICs, and for management and internal Ethernet interfaces, 1 through 1023.<br><br>For 48-port Fast Ethernet and Gigabit Ethernet PICs, 1 through 4094.<br><br>VLAN ID 0 is reserved for tagging the priority of frames. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Mixed Tagging on page 239</a></li> </ul>                                                                                                                                                                                                                                           |

## vlan-id (VLAN ID to Rewrite)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>vlan-id number;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Hierarchy Level</b>          | <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">input-vlan-map</a>],</code><br><code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code><a href="#">input-vlan-map</a>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i></code><br><code><a href="#">output-vlan-map</a>]</code>                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | <p>For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2, 10-Gigabit Ethernet LAN/WAN PIC, and IQ2-E interfaces and aggregated Ethernet using Gigabit Ethernet IQ interfaces, specify the line VLAN identifiers to be rewritten at the input or output interface.</p> <p>You cannot include the <b>vlan-id</b> statement with the <b>swap</b> statement, <b>swap-push</b> statement, <b>push-push</b> statement, or <b>push-swap</b> statement at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> <a href="#">output-vlan-map</a>]</code> hierarchy level. If you include any of those statements in the output VLAN map, the VLAN ID in the outgoing frame is rewritten to the <b>vlan-id</b> statement that you include at the <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]</code> hierarchy level.</p> |
| <b>Required Privilege Level</b> | <code>interface</code> —To view this statement in the configuration.<br><code>interface-control</code> —To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Rewriting the VLAN Tag on Tagged Frames on page 496</a></li><li>• <a href="#">Binding VLAN IDs to Logical Interfaces on page 242</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## vlan-id-list (Ethernet VLAN Circuit)

|                            |                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>vlan-id-list [vlan-id vlan-id–vlan-id];</code>                                                                                                                                        |
| <b>Hierarchy Level</b>     | <code>[edit interfaces interface-name unit logical-unit-number],</code><br><code>[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]</code>       |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.5.                                                                                                                                               |
| <b>Description</b>         | Binds a single-tag logical interface to a list of VLAN IDs. Configures a logical interface to receive and forward any tag frame whose VLAN ID tag matches the list of VLAN IDs you specify. |



### NOTE:

When you create a circuit cross-connect (CCC) using VLAN-bundled single-tag logical interfaces on Layer 2 VPN routing instances, the circuit automatically uses ethernet encapsulation. For Layer 2 VPN, you need to include the `encapsulation-type` statement and specify the value `ethernet` at either of the following hierarchy levels:

- `[edit routing-instances routing-instance-name protocols l2vpn]`
- `[edit logical-systems logical-system-name routing-instances routing-instance-name protocols l2vpn]`

For more information about the `encapsulation-type` configuration statement and the Layer 2 encapsulation types `ethernet` and `ethernet-vlan`, see the *Junos OS VPNs Library for Routing Devices*.

|                |                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Options</b> | <code>[vlan-id vlan-id–vlan-id]</code> —A list of valid VLAN ID numbers. Specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.<br><b>Range:</b> 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames. |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



**NOTE:** Configuring `vlan-id-list` with the entire `vlan-id` range is an unnecessary waste of system resources and is not best practice. It should be used only when a subset of VLAN IDs (not the entire range) needs to be associated with a logical interface. If you specify the entire range (1-4094), it has the same result as not specifying a range; however, it consumes PFE resources such as VLAN lookup tables entries, and so on.

The following examples illustrate this further:

```
[edit interfaces interface-name]
vlan-tagging;
unit number {
```

```
        vlan-id-range 1-4094;  
    }  
  
    [edit interfaces interface-name]  
    unit 0;
```

---

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Binding VLAN IDs to Logical Interfaces on page 242](#)
- [encapsulation \(Logical Interface\) on page 937](#)
- [encapsulation \(Physical Interface\) on page 941](#)
- encapsulation-type (Layer 2 VPN routing instance), see the *Junos OS VPNs Library for Routing Devices*
- [flexible-vlan-tagging on page 970](#)
- [vlan-tagging on page 1246](#)
- [vlan-tags \(Dual-Tagged Logical Interface\) on page 1248](#)

## vlan-id-list (Interface in Bridge Domain)

|                                 |                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>vlan-id-list [ <i>number number-number</i> ];</code>                                                                                                                                                                                                                                                                                                                  |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family bridge],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family bridge]                                                                                                                                                  |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.2.<br>Statement introduced in Junos OS Release 15.1.                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Configure a logical interface to forward packets and learn MAC addresses within each bridge domain configured with a VLAN ID that matches a VLAN ID specified in the list. VLAN IDs can be entered individually using a space to separate each ID, entered as an inclusive list separating the starting VLAN ID and ending VLAN ID with a hyphen, or a combination of both. |
| <b>Options</b>                  | <i>number number</i> —Individual VLAN IDs separated by a space.<br><br><i>number-number</i> —Starting VLAN ID and ending VLAN ID in an inclusive range.<br><b>Range:</b> 1 through 4095                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring a Logical Interface for Trunk Mode on page 252</a></li> <li>• <a href="#">Configuring the VLAN ID List for a Trunk Interface on page 253</a></li> <li>• <i>Tunnel Services Overview</i></li> <li>• <i>Configuring Tunnel Interfaces on MX Series Routers</i></li> </ul>                                    |

## vlan-id-range

---

|                            |                                                                                                                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>vlan-id-range <i>vlan-id-vlan-id</i></code>                                                                                                                                                |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ] |
| <b>Release Information</b> | Statement introduced in Junos OS Release 8.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.                                                                         |
| <b>Description</b>         | Bind a range of VLAN IDs to a logical interface.                                                                                                                                                 |
| <b>Options</b>             | <b>number</b> —The first number is the lowest VLAN ID in the range the second number is the highest VLAN ID in the range.<br><b>Range:</b> 1 through 4094                                        |



**NOTE:** Configuring `vlan-id-range` with the entire `vlan-id` range is an unnecessary waste of system resources and is not best practice. It should be used only when a subset of VLAN IDs (not the entire range) needs to be associated with a logical interface. If you specify the entire range (1-4094), it has the same result as not specifying a range; however, it consumes PFE resources such as VLAN lookup tables entries, and so on.

The following examples illustrate this further:

```
[edit interfaces interface-name]  
vlan-tagging;  
unit number {  
    vlan-id-range 1-4094;  
}  
  
[edit interfaces interface-name]  
unit 0;
```

VLAN ID 0 is reserved for tagging the priority of frames.

|                                 |                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Binding a Range of VLAN IDs to a Logical Interface on page 242</a></li></ul> |

## vlan-rewrite

---

|                                 |                                                                                                                                                                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | vlan-rewrite translate (200 500   201 501)                                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> unit <i>number</i> family bridge interface-mode trunk]<br>[edit interfaces <i>interface-name</i> unit <i>number</i> family ethernet-switching interface-mode trunk]                                |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.<br>Statement introduced in Junos OS Release 12.3R2 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2 for the QFX Series.                                             |
| <b>Description</b>              | Translates an incoming VLAN to a bridge-domain VLAN, corresponding counter translation at egress. Supports translation of VLAN 200 to VLAN 500 and VLAN 201 to VLAN 501. Other valid VLANs pass through without translation.              |
| <b>Options</b>                  | <b>translate 200 500</b> —Translates incoming packets with VLAN 200 to 500.<br><b>translate 201 501</b> —Translates incoming packets with VLAN 201 to 501.<br><b>translate 202 502</b> —Translates incoming packets with VLAN 202 to 502. |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Rewriting a VLAN Tag and Adding a New Tag on page 501</a></li> </ul>                                                                                                                 |

## vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP)

---

|                                 |                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | vlan-rule (high-low   odd-even);                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit chassis fpc slot pic slot forwarding-mode <a href="#">vlan-steering</a> ]                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.4.                                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | <p>Configure the interoperation mode of the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4) when interoperating with 100 gigabit Ethernet interfaces from other vendors.</p> <p>If no VLAN rule is configured, all tagged packets are distributed to PFE0.</p>                                                              |
| <b>Options</b>                  | <p><b>high-low</b>—VLAN IDs 1 through 2047 are distributed to PFE0 and VLAN IDs 2048 through 4096 are distributed to PFE1.</p> <p><b>odd-even</b>—Odd number VLAN IDs are distributed to PFE1 and even number VLAN IDs are distributed to PFE0.</p>                                                                                    |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 406</a></li><li>• <a href="#">forwarding-mode (100-Gigabit Ethernet) on page 974</a></li><li>• <a href="#">vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1245</a></li></ul> |



---

## vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>vlan-steering {<br/>    vlan-rule (high-low   odd-even);<br/>}</code>                                                                                                                                                                                                                                                                                                                                   |
| <b>Hierarchy Level</b>          | [edit chassis fpc slot pic slot forwarding-mode]                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 9.4.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | <p>Configure the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4) to interoperate with 100 gigabit Ethernet interfaces from other vendors.</p> <p>The other statement is explained separately.</p>                                                                                                                                                                                                  |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 406</a></li><li>• <a href="#">forwarding-mode (100-Gigabit Ethernet) on page 974</a></li><li>• <a href="#">sa-multicast (100-Gigabit Ethernet) on page 1162</a></li><li>• <a href="#">vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1244</a></li></ul> |

## vlan-tagging

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | vlan-tagging;                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> ]                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | <p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.</p> <p>Statement introduced in Junos OS Release 13.2 for PTX Series Routers.</p> <p>Statement introduced in Junos OS Release 14.1X53-D10 for the QFX Series.</p>     |
| <b>Description</b>              | For Fast Ethernet and Gigabit Ethernet interfaces and aggregated Ethernet interfaces configured for VPLS, enable the reception and transmission of 802.1Q VLAN-tagged frames on the interface.                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">802.1Q VLANs Overview on page 236</a></li><li>• <i>vlan-id</i></li><li>• <i>Configuring a Layer 3 Subinterface (CLI Procedure)</i></li><li>• <a href="#">Configuring Tagged Aggregated Ethernet Interfaces on page 146</a></li><li>• <i>Example: Configuring Layer 3 Subinterfaces for a Distribution Switch and an Access Switch</i></li></ul> |

## vlan-tags

|                            |                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>vlan-tags outer [<i>tpid</i>].<i>vlan-id</i> [inner [<i>tpid</i>].<i>vlan-id</i>];</code>                                                                                                                                                      |
| <b>Hierarchy Level</b>     | <code>[edit dynamic-profiles <i>profile-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]</code>                                                                                                                            |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.5.<br>VLAN demux interface support introduced in Junos OS Release 10.2.                                                                                                                                   |
| <b>Description</b>         | For Gigabit Ethernet IQ and IQE interfaces only, binds TPIDs and 802.1Q VLAN tag IDs to a logical interface. You must include the <b>stacked-vlan-tagging</b> statement at the <code>[edit interfaces <i>interface-name</i>]</code> hierarchy level. |



**NOTE:** The inner-range *vid1–vid2* option is supported on IQE PICs only.

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Options</b>                  | <p><b>inner [<i>tpid</i>].<i>vlan-id</i></b>—A TPID (optional) and a valid VLAN identifier in the format <i>tpid.vlan-id</i>. When used in the <b>dynamic-profiles</b> hierarchy, specify the <code>\$junos-vlan-id</code> predefined variable to dynamically obtain the VLAN ID.</p> <p><b>Range:</b> For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.</p> <p><b>outer [<i>tpid</i>].<i>vlan-id</i></b>—A TPID (optional) and a valid VLAN identifier in the format <i>tpid.vlan-id</i>. When used in the <b>dynamic-profiles</b> hierarchy, specify the <code>\$junos-stacked-vlan-id</code> predefined variable.</p> <p><b>Range:</b> For VLAN ID, 1 through 511 for normal interfaces, and 512 through 4094 for VLAN CCC interfaces. VLAN ID 0 is reserved for tagging the priority of frames.</p> |
| <b>Required Privilege Level</b> | <p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Dual VLAN Tags on page 489</a></li> <li>• <a href="#">stacked-vlan-tagging on page 1186</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## vlan-tags (Dual-Tagged Logical Interface)

|                            |                                                                                                                                                                                                                                 |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>vlan-tags inner-list [<i>vlan-id vlan-id-vlan-id</i>] outer &lt;<i>tpid</i>&gt;<i>vlan-id</i>;</code>                                                                                                                     |
| <b>Hierarchy Level</b>     | <code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>],</code><br><code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]</code>        |
| <b>Release Information</b> | Statement introduced in Junos OS Release 9.5.                                                                                                                                                                                   |
| <b>Description</b>         | (MX Series routers only) Binds a dual-tag logical interface to a list of VLAN IDs. Configures the logical interface to receive and forward any dual-tag frame whose inner VLAN ID tag matches the list of VLAN IDs you specify. |



### NOTE:

To create a circuit cross-connect (CCC) using VLAN-bundled dual-tag logical interfaces on Layer 2 VPN routing instances, you must include the `encapsulation-type` statement and specify the value `ethernet-vlan` at the one of the following hierarchy levels:

- `[edit routing-instances routing-instance-name protocols l2vpn]`
- `[edit logical-systems logical-system-name routing-instances routing-instance-name protocols l2vpn]`

For more information about the `encapsulation-type` configuration statement and the Layer 2 encapsulation types `ethernet` and `ethernet-vlan`, see the *Junos OS VPNs Library for Routing Devices*.

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Options</b> | <p><code>inner-list [<i>vlan-id vlan-id vlan-id-vlan-id</i>]</code>—A list of valid VLAN ID numbers. Specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.</p> <p><b>Range:</b> 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.</p> <p><code>outer &lt;<i>tpid</i>&gt;<i>vlan-id</i></code>—An optional Tag Protocol ID (TPID) and a valid VLAN ID.</p> <p><b>Range:</b> For TPID, specify a hexadecimal value in the format <code>0xnnnn</code>.</p> <p><b>Range:</b> For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.</p> |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



**NOTE:** Configuring `inner-list` with the entire `vlan-id` range is an unnecessary waste of system resources and is not best practice. It should be used only when a subset of VLAN IDs of inner tag (not the entire range) needs to be associated with a logical interface. If you specify the entire range (1 through 4094), it has the same result as not specifying a range; however, it consumes PFE resources such as VLAN lookup tables entries, and so on.

The following examples illustrate this further:

```
[edit interfaces interface-name]
vlan-tagging;
unit number {
    vlan-tags outer vid inner-list 1-4094;
}

[edit interfaces interface-name]
vlan-tagging;
unit number {
    vlan-id vid;
}
```

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Binding VLAN IDs to Logical Interfaces on page 242</a></li> <li>• <a href="#">encapsulation (Logical Interface) on page 937</a></li> <li>• <a href="#">encapsulation (Physical Interface) on page 941</a></li> <li>• encapsulation-type (Layer 2 VPN routing instance), see the <i>Junos OS VPNs Library for Routing Devices</i>.</li> <li>• <a href="#">flexible-vlan-tagging on page 970</a></li> <li>• <a href="#">vlan-id-list (Ethernet VLAN Circuit) on page 1239</a></li> <li>• <a href="#">vlan-tagging on page 1246</a></li> </ul> |

## vlan-tags (Stacked VLAN Tags)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>vlan-tags inner <i>tpid.vlan-id</i> inner-range <i>vid1—vid2</i> outer <i>tpid.vlan-id</i>;</code>                                                                                                                                                                                                                                                                                                           |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> ],<br>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> <b>unit</b> <i>logical-unit-number</i> ]                                                                                                                                                                                                            |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.                                                                                                                                                                                                                                                                     |
| <b>Description</b>         | For Gigabit Ethernet IQ and IQE interfaces only, bind TPIDs and 802.1Q VLAN tag IDs to a logical interface.                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>             | <b>inner <i>tpid.vlan-id</i></b> —A TPID and a valid VLAN identifier.<br><b>Range:</b> (most routers) For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames. For PTX Series, VLAN ID 0 is not supported.<br><b>inner-range <i>tpid. vid1—vid2</i></b> —Specify a TPID and a range of VLAN IDs where <i>vid1</i> is the start of the range and <i>vid2</i> is the end of the range. |



**NOTE:** On the network-to-network (NNI) or egress interfaces of provider edge (PE) routers, you cannot configure the inner-range *tpid. vid1—vid2* option with the `vlan-tags` statement for ISP-facing interfaces.

**Range:** For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

**outer *tpid.vlan-id***—A TPID and a valid VLAN identifier.

**Range:** (most routers) For VLAN ID, 1 through 511 for normal interfaces, and 512 through 4094 for VLAN CCC interfaces. VLAN ID 0 is reserved for tagging the priority of frames. For PTX Series, VLAN ID 0 is not supported.



**NOTE:** Configuring inner-range with the entire `vlan-id` range consumes system resources and is not a best practice. It should be used only when a subset of VLAN IDs of inner tag (not the entire range) needs to be associated with a logical interface. If you specify the entire range (1–4094), it has the same result as not specifying a range; however, it consumes Packet Forwarding Engine resources such as VLAN lookup table entries, and so on.

The following examples illustrate this further:

```
[edit interfaces interface-name]
  stacked-vlan-tagging;
  unit number {
    vlan-tags outer vid inner-range 1-4094;
  }
```

```
[edit interfaces interface-name]
vlan-tagging;
unit number {
    vlan-id vid;
}
```

---

|                                 |                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Configuring Dual VLAN Tags on page 489</a></li> <li>• <a href="#">Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 241</a></li> <li>• <a href="#">stacked-vlan-tagging on page 1186</a></li> </ul> |

## wait-to-block-interval

---

|                                 |                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | wait-to-block-interval <i>number</i> ;                                                                                                                                                                                |
| <b>Hierarchy Level</b>          | [edit protocols <a href="#">protection-group ethernet-ring ring-name</a> ]                                                                                                                                            |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 14.2.                                                                                                                                                                        |
| <b>Description</b>              | Enable the Wait to Block (WTB) timer interval when clearing force switch and manual switch commands.                                                                                                                  |
| <b>Options</b>                  | <i>number</i> —Wait-to-block interval, in seconds.<br><b>Range:</b> 5 through 10 s<br><b>Default:</b> 5 s                                                                                                             |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Ethernet Ring Protection Switching Overview on page 213</a></li> <li>• <a href="#">Configuring Ethernet Ring Protection Switching (CLI Procedure)</a></li> </ul> |

## warning

---

|                                 |                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>warning low-light-warning {<br/>  (link-down   syslog);<br/>}</pre>                                                                                                                                                                                                                                                     |
| <b>Hierarchy Level</b>          | [edit interfaces <i>interface-name</i> optics-options]                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Statement introduced in Junos OS Release 10.0.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers.                                                                                                                             |
| <b>Description</b>              | Specifies the action to take if the receiving optics signal is below the optics low-light warning threshold.                                                                                                                                                                                                                 |
| <b>Options</b>                  | <b>link-down</b> —Drop the 10-Gigabit Ethernet link and marks link as down.<br><b>syslog</b> —Write the optics information to the system log.                                                                                                                                                                                |
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration.                                                                                                                                                                                                      |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 390</a></li><li>• <a href="#">optics-options on page 1097</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li></ul> |



## wavelength

|                            |                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>              | <code>wavelength <i>nm</i>;</code>                                                                                                                                                                  |
| <b>Hierarchy Level</b>     | [edit interfaces <i>interface-name</i> <b>optics-options</b> ]                                                                                                                                      |
| <b>Release Information</b> | Statement introduced before Junos OS Release 7.4.<br>Statement introduced in Junos OS Release 12.1 for EX Series switches.<br>Statement introduced in Junos OS Release 13.2 for PTX Series routers. |
| <b>Description</b>         | For 10-Gigabit or 100-Gigabit Ethernet DWDM interfaces only, configure full C-band ITU-Grid tunable optics.                                                                                         |
| <b>Options</b>             | <i>nm</i> —Wavelength value. It can be one of the following:                                                                                                                                        |



**NOTE:** All values are displayed. However, if you configure a value that is not supported by the device, an error message is displayed and the device is not tuned to the specified wavelength.

- **1528.38**—1528.38 nanometers (nm), corresponds to a 50-GHz grid
- **1528.77**—1528.77 nm, corresponds to 50-GHz and 100-GHz grids
- **1529.16**—1529.16 nm, corresponds to a 50-GHz grid
- **1529.55**—1529.55 nm, corresponds to 50-GHz and 100-GHz grids
- **1529.94**—1529.94 nm, corresponds to a 50-GHz grid
- **1530.33**—1530.33 nm, corresponds to 50-GHz and 100-GHz grids
- **1530.72**—1530.72 nm, corresponds to a 50-GHz grid
- **1531.12**—1531.12 nm, corresponds to 50-GHz and 100-GHz grids
- **1531.51**—1531.51 nm, corresponds to a 50-GHz grid
- **1531.90**—1531.90 nm, corresponds to 50-GHz and 100-GHz grids
- **1532.29**—1532.29 nm, corresponds to a 50-GHz grid
- **1532.68**—1532.68 nm, corresponds to 50-GHz and 100-GHz grids
- **1533.07**—1533.07 nm, corresponds to a 50-GHz grid
- **1533.47**—1533.47 nm, corresponds to 50-GHz and 100-GHz grids
- **1533.86**—1533.86 nm, corresponds to a 50-GHz grid
- **1534.25**—1534.25 nm, corresponds to 50-GHz and 100-GHz grids
- **1534.64**—1534.64 nm, corresponds to a 50-GHz grid
- **1535.04**—1535.04 nm, corresponds to 50-GHz and 100-GHz grids

- **1535.43**—1535.43 nm, corresponds to a 50-GHz grid
- **1535.82**—1535.82 nm, corresponds to 50-GHz and 100-GHz grids
- **1536.22**—1536.22 nm, corresponds to a 50-GHz grid
- **1536.61**—1536.61 nm, corresponds to 50-GHz and 100-GHz grids
- **1537.00**—1537.00 nm, corresponds to a 50-GHz grid
- **1537.40**—1537.40 nm, corresponds to 50-GHz and 100-GHz grids
- **1537.79**—1537.79 nm, corresponds to a 50-GHz grid
- **1538.19**—1538.19 nm, corresponds to 50-GHz and 100-GHz grids
- **1538.58**—1538.58 nm, corresponds to a 50-GHz grid
- **1538.98**—1538.98 nm, corresponds to 50-GHz and 100-GHz grids
- **1539.37**—1539.37 nm, corresponds to a 50-GHz grid
- **1539.77**—1539.77 nm, corresponds to 50-GHz and 100-GHz grids
- **1540.16**—1540.16 nm, corresponds to a 50-GHz grid
- **1540.56**—1540.56 nm, corresponds to 50-GHz and 100-GHz grids
- **1540.95**—1540.95 nm, corresponds to a 50-GHz grid
- **1541.35**—1541.35 nm, corresponds to 50-GHz and 100-GHz grids
- **1541.75**—1541.75 nm, corresponds to a 50-GHz grid
- **1542.14**—1542.14 nm, corresponds to 50-GHz and 100-GHz grids
- **1542.54**—1542.54 nm, corresponds to a 50-GHz grid
- **1542.94**—1542.94 nm, corresponds to 50-GHz and 100-GHz grids
- **1543.33**—1543.33 nm, corresponds to a 50-GHz grid
- **1543.73**—1543.73 nm, corresponds to 50-GHz and 100-GHz grids
- **1544.13**—1544.13 nm, corresponds to a 50-GHz grid
- **1544.53**—1544.53 nm, corresponds to 50-GHz and 100-GHz grids
- **1544.92**—1544.92 nm, corresponds to a 50-GHz grid
- **1545.32**—1545.32 nm, corresponds to 50-GHz and 100-GHz grids
- **1545.72**—1545.72 nm, corresponds to a 50-GHz grid
- **1546.12**—1546.12 nm, corresponds to 50-GHz and 100-GHz grids
- **1546.52**—1546.52 nm, corresponds to a 50-GHz grid
- **1546.92**—1546.92 nm, corresponds to 50-GHz and 100-GHz grids
- **1547.32**—1547.32 nm, corresponds to a 50-GHz grid
- **1547.72**—1547.72 nm, corresponds to 50-GHz and 100-GHz grids
- **1548.11**—1548.11 nm, corresponds to a 50-GHz grid

- **1548.51**—1548.51 nm, corresponds to 50-GHz and 100-GHz grids
- **1548.91**—1548.91 nm, corresponds to a 50-GHz grid
- **1549.32**—1549.32 nm, corresponds to 50-GHz and 100-GHz grids
- **1549.72**—1549.72 nm, corresponds to a 50-GHz grid
- **1550.12**—1550.12 nm, corresponds to 50-GHz and 100-GHz grids
- **1550.52**—1550.52 nm, corresponds to a 50-GHz grid
- **1550.92**—1550.92 nm, corresponds to 50-GHz and 100-GHz grids
- **1551.32**—1551.32 nm, corresponds to a 50-GHz grid
- **1551.72**—1551.72 nm, corresponds to 50-GHz and 100-GHz grids
- **1552.12**—1552.12 nm, corresponds to a 50-GHz grid
- **1552.52**—1552.52 nm, corresponds to 50-GHz and 100-GHz grids
- **1552.93**—1552.93 nm, corresponds to a 50-GHz grid
- **1553.33**—1554.33 nm, corresponds to 50-GHz and 100-GHz grids
- **1553.73**—1554.73 nm, corresponds to a 50-GHz grid
- **1554.13**—1554.13 nm, corresponds to 50-GHz and 100-GHz grids
- **1554.54**—1554.54 nm, corresponds to a 50-GHz grid
- **1554.94**—1554.94 nm, corresponds to 50-GHz and 100-GHz grids
- **1555.34**—1555.34 nm, corresponds to a 50-GHz grid
- **1555.75**—1555.75 nm, corresponds to 50-GHz and 100-GHz grids
- **1556.15**—1556.15 nm, corresponds to a 50-GHz grid
- **1556.55**—1556.55 nm, corresponds to 50-GHz and 100-GHz grids
- **1556.96**—1556.96 nm, corresponds to a 50-GHz grid
- **1557.36**—1557.36 nm, corresponds to 50-GHz and 100-GHz grids
- **1557.77**—1557.77 nm, corresponds to a 50-GHz grid
- **1558.17**—1558.17 nm, corresponds to 50-GHz and 100-GHz grids
- **1558.58**—1558.58 nm, corresponds to a 50-GHz grid
- **1558.98**—1558.98 nm, corresponds to 50-GHz and 100-GHz grids
- **1559.39**—1559.39 nm, corresponds to a 50-GHz grid
- **1559.79**—1559.79 nm, corresponds to 50-GHz and 100-GHz grids
- **1560.20**—1560.20 nm, corresponds to a 50-GHz grid
- **1560.61**—1560.61 nm, corresponds to 50-GHz and 100-GHz grids
- **1561.01**—1561.01 nm, corresponds to a 50-GHz grid
- **1561.42**—1561.42 nm, corresponds to 50-GHz and 100-GHz grids

- **1561.83**—1561.83 nm, corresponds to a 50-GHz grid
- **1562.23**—1562.23 nm, corresponds to 50-GHz and 100-GHz grids
- **1562.64**—1562.64 nm, corresponds to a 50-GHz grid
- **1563.05**—1563.05 nm, corresponds to 50-GHz and 100-GHz grids
- **1563.45**—1563.45 nm, corresponds to a 50-GHz grid
- **1563.86**—1563.86 nm, corresponds to 50-GHz and 100-GHz grids
- **1564.27**—1564.27 nm, corresponds to a 50-GHz grid
- **1564.68**—1564.68 nm, corresponds to 50-GHz and 100-GHz grids
- **1565.09**—1565.09 nm, corresponds to a 50-GHz grid
- **1565.50**—1565.50 nm, corresponds to 50-GHz and 100-GHz grids
- **1565.90**—1565.90 nm, corresponds to a 50-GHz grid
- **1566.31**—1566.31 nm, corresponds to 50-GHz and 100-GHz grids
- **1566.72**—1566.72 nm, corresponds to a 50-GHz grid
- **1567.13**—1567.13 nm, corresponds to 50-GHz and 100-GHz grids
- **1567.54**—1567.54 nm, corresponds to a 50-GHz grid
- **1567.95**—1567.95 nm, corresponds to 50-GHz and 100-GHz grids
- **1568.36**—1568.36 nm, corresponds to a 50-GHz grid
- **1568.77**—1568.77 nm, corresponds to 50-GHz and 100-GHz grids

**Default:** 1550.12—1550.12 nm, corresponds to 50-GHz and 100-GHz grids

|                                 |                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Required Privilege Level</b> | interface—To view this statement in the configuration.<br>interface-control—To add this statement to the configuration. |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Related Documentation</b> | <ul style="list-style-type: none"><li>• <a href="#">Ethernet DWDM Interface Wavelength Overview on page 381</a></li><li>• <a href="#">Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 381</a></li><li>• <a href="#">show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port) on page 1528</a></li></ul> |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## west-interface

**Syntax**

```
west-interface {
  node-id mac-address;
  control-channel channel-name {
    vlan number;
    interface name interface-name
  }
  interface-none
  ring-protection-link-end;
  virtual-control-channel {
    west-interface name;
    east-interface name;
  }
}
```

**Hierarchy Level** [edit protocols [protection-group ethernet-ring ring-name](#)]

**Release Information** Statement introduced in Junos OS Release 9.5.  
Statement introduced in Junos OS Release 12.1 for EX Series switches.  
Statement introduced in Junos OS Release 14.153-D10 for QFX Series switches.

**Description** Define one of the two interface ports for Ethernet ring protection, the other being defined by the **east-interface** statement at the same hierarchy level. The interface must use the control channel's logical interface name. The control channel is a dedicated VLAN channel for the ring port.



**NOTE:** Always configure this port second, after configuring the **east-interface** statement.

The statements are explained separately.

**Required Privilege Level** interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Ring Protection Switching Overview on page 213](#)
- [Ethernet Ring Protection Using Ring Instances for Load Balancing on page 739](#)
- [east-interface on page 935](#)
- [ethernet-ring on page 954](#)
- [Example: Configuring Ethernet Ring Protection Switching on EX Series Switches](#)
- [Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS](#)
- [Configuring Ethernet Ring Protection Switching \(CLI Procedure\)](#)



## CHAPTER 37

# Operational Commands

- clear interfaces interface-set statistics
- clear interfaces interval
- clear interfaces aeX forwarding-options load-balance state
- clear interfaces aggregate forwarding-options load-balance state
- clear interfaces transport pm
- clear lldp neighbors
- clear lldp statistics
- clear oam ethernet connectivity-fault-management continuity-measurement
- clear oam ethernet connectivity-fault-management linktrace path-database
- clear oam ethernet connectivity-fault-management loss-statistics
- clear oam ethernet connectivity-fault-management policer
- clear oam ethernet connectivity-fault-management statistics
- clear oam ethernet connectivity-fault-management synthetic-loss-measurement
- clear oam ethernet link-fault-management state
- clear oam ethernet link-fault-management statistics
- clear protection-group ethernet-ring statistics
- clear security mka statistics (MX Series)
- clear security mka statistics (MX Series)
- monitor ethernet delay-measurement
- monitor ethernet loss-measurement
- monitor ethernet synthetic-loss-measurement
- request interface mc-ae switchover (Multichassis Link Aggregation)
- request interface (revert | switchover) (Aggregated Ethernet Link Protection)
- request lacp link-switchover
- show chassis hardware
- show chassis pic
- show iccp
- show interfaces (Adaptive Services)

- `show interfaces (Aggregated Ethernet)`
- `show interfaces demux0 (Demux Interfaces)`
- `show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port)`
- `show interfaces (far-end-interval)`
- `show interfaces (Fast Ethernet)`
- `show interfaces (Gigabit Ethernet)`
- `show interfaces (10-Gigabit Ethernet)`
- `show interfaces (M Series, MX Series, T Series Routers, and PTX Series Management and Internal Ethernet)`
- `show interfaces (PPPoE)`
- `show interfaces interface-set (Ethernet Interface Set)`
- `show interfaces interface-set queue`
- `show interfaces interval`
- `show interfaces irb`
- `show interfaces mac-database`
- `show interfaces mc-ae`
- `show interfaces transport pm`
- `show l2-learning instance`
- `show l2-learning redundancy-groups`
- `show lacp interfaces`
- `show lldp`
- `show lldp local-information`
- `show lldp neighbors`
- `show lldp remote-global-statistics`
- `show lldp statistics`
- `show oam ethernet connectivity-fault-management delay-statistics`
- `show oam ethernet connectivity-fault-management forwarding-state`
- `show oam ethernet connectivity-fault-management interfaces`
- `show oam ethernet connectivity-fault-management linktrace path-database`
- `show oam ethernet connectivity-fault-management loss-statistics`
- `show oam ethernet connectivity-fault-management mep-database`
- `show oam ethernet connectivity-fault-management mep-statistics`
- `show oam ethernet connectivity-fault-management path-database`
- `show oam ethernet connectivity-fault-management policer`
- `show oam ethernet connectivity-fault-management sla-iterator-statistics`
- `show oam ethernet connectivity-fault-management synthetic-loss-statistics`
- `show oam ethernet evc`



- `show oam ethernet fnp interface`
- `show oam ethernet fnp messages`
- `show oam ethernet fnp status`
- `show oam ethernet link-fault-management`
- `show oam ethernet lmi`
- `show oam ethernet lmi statistics`
- `show pppoe interfaces`
- `show pppoe service-name-tables`
- `show pppoe sessions`
- `show pppoe statistics`
- `show pppoe underlying-interfaces`
- `show pppoe version`
- `show protection-group ethernet-ring aps`
- `show protection-group ethernet-ring configuration`
- `show protection-group ethernet-ring data-channel`
- `show protection-group ethernet-ring flush-info`
- `show protection-group ethernet-ring interface`
- `show protection-group ethernet-ring node-state`
- `show protection-group ethernet-ring statistics`
- `show protection-group ethernet-ring vlan`
- `show security macsec connections (MX Series)`
- `show security macsec statistics (MX Series)`
- `show security mka sessions (MX Series)`
- `show security mka statistics (MX Series)`
- `show vrrp`
- `traceroute ethernet`

## clear interfaces interface-set statistics

---

|                                 |                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear interfaces interface-set statistics <i>interface-set-name</i>                                                                                                                                                 |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.                                                                                                                                                                         |
| <b>Description</b>              | Set interface set statistics to zero.                                                                                                                                                                               |
| <b>Options</b>                  | <i>interface-set-name</i> —Set statistics on a specified interface set to zero. Wildcard values can be used in the interface set name. This command will not clear the statistics of the member logical interfaces. |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                               |
| <b>List of Sample Output</b>    | <a href="#">clear interfaces interface-set statistics on page 1262</a>                                                                                                                                              |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                               |

### Sample Output

#### clear interfaces interface-set statistics

```
user@host> clear interfaces interface-set statistics
```

## clear interfaces interval

|                                 |                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear interfaces interval <i>interface-name</i>                                                                                                                                                               |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                               |
| <b>Description</b>              | Clear the channel service unit (CSU) alarm and defect counters so that only the current time interval is displayed. This operation affects the <b>show interface interval</b> command, but not an SNMP query. |
| <b>Options</b>                  | <i>interface-name</i> —Name of a particular interface.                                                                                                                                                        |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show interfaces interval on page 1665</a></li> </ul>                                                                                                     |
| <b>List of Sample Output</b>    | <a href="#">clear interfaces interval on page 1263</a>                                                                                                                                                        |
| <b>Output Fields</b>            | See <a href="#">show interfaces interval</a> for an explanation of output fields.                                                                                                                             |

## Sample Output

### clear interfaces interval

The following example displays the output for a T3 interface before and after the **clear interfaces** command is entered:

```

user@host> show interfaces interval t3-0/3/0:4
Physical interface: t3-0/3/0:4, SNMP ifIndex: 23
  17:43-current:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:28-17:43:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:13-17:28:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:58-17:13:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:43-16:58:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:28-16:43:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    CES: 195, CSES: 195, SEFS: 195, UAS: 206
  14:58-15:13:
    LCV: 35, PCV: 163394, CCV: 54485, LES: 0, PES: 35, PSES: 35, CES:
    35, CSES: 35, SEFS: 35, UAS: 32
  Interval Total:
    LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
    CES: 230, CSES: 230, SEFS: 230, UAS: 238

```

```
user@host> clear interfaces interval t3-0/3/0:4
```

```
user@host> show interfaces interval t3-0/3/0:4
Physical interface: t3-0/3/0:4, SNMP ifIndex: 23
  17:43-current:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  Interval Total:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0, SEFS: 0,
    UAS: 0
```

## clear interfaces aeX forwarding-options load-balance state

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | clear interfaces aeX unit <i>logical-unit-number</i> aggregate forwarding-options load-balance state                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Release Information      | Command introduced in Junos OS Release 13.2R1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description              | <p>Clear the specified aggregate Ethernet interface load balancing state and re-create it newly. If the traffic flows become aged frequently, then the device needs to remove or refresh the load balancing states. As a result, you must configure rebalancing or run the clear command at periodic intervals for proper load-balancing. Otherwise, traffic skewing can occur.</p> <p>If you observe load distribution to be not very effective, you can clear the load-balancing states or use rebalancing functionality to cause an automatic clearance of the hardware states. When you configure the rebalancing facility, traffic flows can get redirected to different links, which can cause packet reordering.</p> |
| Options                  | <p><b>aeX</b>—Name of a particular aggregated Ethernet interface.</p> <p><b>logical-unit-number</b>—Number of the logical unit of the interface.</p> <p><b>forwarding-options load-balance state</b>—Cause the load-balancing state to be cleared for the specific interface.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Required Privilege Level | clear                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">show interfaces interval on page 1665</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| List of Sample Output    | <a href="#">clear interfaces aeX aggregate forwarding-options on page 1266</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

### Sample Output

#### clear interfaces aeX aggregate forwarding-options

```
user@host> clear interfaces ae1 aggregate forwarding-options load-balance state
```

## [clear interfaces aggregate forwarding-options load-balance state](#)

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear interfaces aggregate forwarding-options load-balance state                                                                                                                                                                                                                                                                                                          |
| <b>Release Information</b>      | Command introduced in Junos OS Release 13.2R1.                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Clear all the aggregate Ethernet interface load balancing states and re-create them newly. If the traffic flows become aged frequently, then the device needs to remove or refresh the load balancing states. As a result, you must configure rebalancing or run the clear command at periodic intervals for proper load-balancing. Otherwise, traffic skewing can occur. |
| <b>Options</b>                  | <i>interface-name</i> —Name of a particular interface.                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show interfaces interval on page 1665</a></li></ul>                                                                                                                                                                                                                                                                   |
| <b>List of Sample Output</b>    | <a href="#">clear interfaces aggregate forwarding-options on page 1267</a>                                                                                                                                                                                                                                                                                                |

### Sample Output

#### [clear interfaces aggregate forwarding-options](#)

```
user@host> clear interfaces aggregate forwarding-options load-balance state
```

## clear interfaces transport pm

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear interfaces transport pm (all   optics   otn) (all   current   current-day) (all   <i>interface-name</i> )                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Command introduced in Junos OS Release 14.2 on the PTX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Clear optics and OTN information from the transport performance monitoring data.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Options</b>                  | <p>(all   optics   otn)—Clear both optics and OTN information or either only optics or only OTN information.</p> <p>(all   current   current-day)—Clear information for the current 15-minute interval, the ninety-six 15-minute intervals, the current day, and the previous day; information only for the current 15-minute interval; or information only for the current 24 hours.</p> <p>(all   <i>interface-name</i>)—Clear information for all interfaces or only for the specified interface (for example, <i>et-fpc/pic/port</i>).</p> |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show interfaces transport pm on page 1683</a></li><li>• <a href="#">100-Gigabit Ethernet OTN Options Configuration Overview on page 430</a></li><li>• <a href="#">tca on page 1201</a></li></ul>                                                                                                                                                                                                                                                                                           |
| <b>List of Sample Output</b>    | <a href="#">clear interfaces transport pm on page 1268</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

### Sample Output

#### clear interfaces transport pm

```
user@host> clear interfaces transport pm transport otn current all
```



## clear lldp neighbors

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>clear lldp neighbor</code><br><code>&lt;interface <i>interface-name</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | <p>Clear information regarding all Link Layer Discovery Protocol (LLDP) neighbors or LLDP neighbors of the specified interface.</p> <p>For information about interface names, see <i>Interface Naming Overview</i>. For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i>. For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i>.</p> <p>For information about interface names in the Junos Fusion technology, see <i>Understanding Junos Fusion Ports</i>.</p> |
| <b>Options</b>                  | <code>interface <i>interface-name</i></code> —(Optional) Clear the LLDP neighbors on the specified interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear lldp statistics on page 1270</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>List of Sample Output</b>    | <a href="#">clear lldp neighbors on page 1269</a><br><a href="#">clear lldp neighbors interface ge-0/1/1.0 on page 1269</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Output Fields</b>            | When you enter this command, you are provided no feedback on the status of your request. You can enter the <code>show lldp neighbors</code> command before and after clearing the LLDP neighbors to verify the clear operation.                                                                                                                                                                                                                                                                                                                                                                    |

### Sample Output

#### clear lldp neighbors

```
user@switch> clear lldp neighbors
```

#### clear lldp neighbors interface ge-0/1/1.0

```
user@switch> clear lldp neighbors interface ge-0/1/1.0
```

## clear lldp statistics

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>clear lldpp neighbor</code><br><code>&lt;interface <i>interface-name</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>Clear all Link Layer Discovery Protocols (LLDP) statistics or LLDP statistics associated with the specified interface.</p> <p>For information about interface names, see <i>Interface Naming Overview</i>. For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i>. For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i>.</p> <p>For information about interface names in the Junos Fusion technology, see <i>Understanding Junos Fusion Ports</i>.</p> |
| <b>Options</b>                  | <code>interface <i>interface-name</i></code> —(Optional) Clear LLDP statistics on the specified interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear lldp neighbors on page 1269</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>List of Sample Output</b>    | <a href="#">clear lldp statistics on page 1270</a><br><a href="#">clear lldp statistics interface ge-0/1/1.0 on page 1270</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Output Fields</b>            | When you enter this command, you are provided no feedback on the status of your request. You can enter the <code>show lldp statistics</code> command before and after clearing the LLDP statistics to verify the clear operation.                                                                                                                                                                                                                                                                                                                                                            |

### Sample Output

#### clear lldp statistics

```
user@switch> clear lldp statistics
```

#### clear lldp statistics interface ge-0/1/1.0

```
user@switch> clear lldp statistics interface ge-0/1/1.0
```

## clear oam ethernet connectivity-fault-management continuity-measurement

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear oam ethernet connectivity-fault-management continuity-measurement<br>maintenance-domain <i>md-name</i><br>maintenance-association <i>ma-name</i><br><local-mep <i>local-mep-id</i> ><br><remote-mep <i>remote-mep-id</i> >                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | For all routers that support IEEE 802.1ag OAM connectivity fault management (CFM), clear the existing continuity measurement and restart counting the operational uptime (that is, the total time during which CCM adjacency is active for a particular remote MEP.).                                                                                                                                                                                                                      |
| <b>Options</b>                  | <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing CFM maintenance domain.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association.</p> <p><b>local-mep <i>local-mep-id</i></b>—(Optional) Display connectivity fault management information for the specified local MEP only.</p> <p><b>remote-mep <i>remote-mep-id</i></b>—(Optional) Display connectivity fault management information for the specified remote MEP only.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Managing Continuity Measurement Statistics on page 691</a></li> <li>• <i>Ethernet Interfaces Feature Guide for Routing Devices</i></li> </ul>                                                                                                                                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet connectivity-fault-management continuity-measurement on page 1271</a>                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                      |

### Sample Output

#### clear oam ethernet connectivity-fault-management continuity-measurement

```
user@host> clear oam ethernet connectivity-fault-management continuity-measurement
maintenance-domain md5 maintenance-association ma5 local-mep 100 remote-mep 102
Continuity measurement restarted.
```

## clear oam ethernet connectivity-fault-management linktrace path-database

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>clear oam ethernet connectivity-fault-management linktrace path-database mac-address maintenance-association <i>ma-name</i> maintenance-domain <i>md-name</i></b>                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.0.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Clear all the linktrace entries and the relevant path information from the database for a particular remote host on M320, MX Series, T320, and T640 routers.                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p><b>mac-address</b>—Clear connectivity fault management path database information for the specified MAC address of the remote host.</p> <p><b>maintenance-association <i>ma-name</i></b>—Clear connectivity fault management path database information for the specified maintenance association.</p> <p><b>maintenance-domain <i>md-name</i></b>—Clear connectivity fault management path database information for the specified maintenance domain.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

### Sample Output

#### clear oam ethernet connectivity-fault-management linktrace path-database

```
user@host> clear oam ethernet connectivity-fault-management linktrace path-database
maintenance-domain md1 maintenance-association ma3 00058573e483
This command produces no output.
```

## clear oam ethernet connectivity-fault-management loss-statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>clear oam ethernet connectivity-fault-management loss-statistics</code><br><code>&lt;interface ethernet-interface-name&gt;</code><br><code>&lt;level md-level&gt;</code>                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | <p>For all routers that support IEEE 802.1ag OAM connectivity fault management (CFM), clear all loss statistics maintained by CFM for a given maintenance domain and maintenance association.</p> <p>In addition, for Ethernet interfaces on MX Series routers, clear any ITU-T Y.1731 Ethernet frame loss measurement (ETH-LM) statistics.</p> <p>By default, the command clears ETH-LM statistics for CFM maintenance association end points (MEPs) attached to any interface on the router.</p> |
| <b>Options</b>                  | <p><code>interface ethernet-interface-name</code>—(Optional) Clear ETH-LM statistics and ETH-LM frame counts only for MEPs attached to the specified Ethernet physical interface.</p> <p><code>level md-level</code>—(Optional) Clear ETH-LM statistics and ETH-LM frame counts only for MEPs within CFM maintenance domains (MDs) of the specified level.</p>                                                                                                                                     |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Clearing ETH-LM Statistics on page 691</a></li> <li>• <a href="#">Displaying ETH-LM Statistics on page 690</a></li> <li>• <a href="#">Managing ETH-LM Statistics on page 690</a></li> </ul>                                                                                                                                                                                                                                                   |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet connectivity-fault-management loss-statistics on page 1273</a>                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                              |

### Sample Output

#### clear oam ethernet connectivity-fault-management loss-statistics

```
user@host> clear oam ethernet connectivity-fault-management loss-statistics
Cleared loss measurements statistics of all CFM sessions
```

## clear oam ethernet connectivity-fault-management policer

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear oam ethernet connectivity-fault-management policer maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | On M7i and M10i with the Enhanced CFEB (CFEB-E), M320, M120, MX Series, T320, and T640 routers, clear connectivity-fault-management policer statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p>The following options are supported:</p> <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing CFM maintenance domain. If this option is not specified, policer statistics are cleared for all maintenance associations for all maintenance domains.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association. If this option is not specified, policer statistics are cleared for all maintenance associations for given maintenance domain. This option cannot be specified without specifying maintenance-domain name.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">show oam ethernet connectivity-fault-management policer on page 1766</a></li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

### clear oam ethernet connectivity-fault-management policer

```
user@host> clear oam ethernet connectivity-fault-management policer
Policer statistics cleared
```

### clear oam ethernet connectivity-fault-management policer maintenance-domain *md-name* maintenance-association *ma-name*

```
user@host> clear oam ethernet connectivity-fault-management policer
maintenance-domain md5 maintenance-association ma5-1
Policer statistics cleared
```

## clear oam ethernet connectivity-fault-management statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>clear oam ethernet connectivity-fault-management statistics</code><br><code>&lt;interface <i>ethernet-interface-name</i>&gt;</code><br><code>&lt;level <i>md-level</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.<br>Support for ETH-DM statistics and frame counts added in Junos OS Release 9.5.                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | For all routers that support IEEE 802.1ag OAM connectivity-fault management (CFM), clear all statistics maintained by CFM.<br><br>In addition, for Ethernet interfaces on Dense Port Concentrators (DPCs) in MX Series routers only, also clear any ITU-T Y.1731 Ethernet frame delay measurement (ETH-DM) statistics and ETH-DM frame counts.<br><br>By default, the command clears CFM statistics and ETH-DM statistics and frame counts for CFM maintenance association end points (MEPs) attached to any interface on the router. |
| <b>Options</b>                  | <b><i>ethernet-interface-name</i></b> —(Optional) Clear CFM statistics, ETH-DM statistics, and ETH-DM frame counts only for MEPs attached to the specified Ethernet physical interface.<br><br><b><i>level</i></b> —(Optional) Clear CFM statistics, ETH-DM statistics, and ETH-DM frame counts only for MEPs within CFM maintenance domains (MDs) of the specified level.                                                                                                                                                            |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show oam ethernet connectivity-fault-management delay-statistics on page 1716</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management interfaces on page 1724</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-database on page 1742</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li> </ul>                                                                      |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

### Sample Output

clear oam ethernet connectivity-fault-management statistics

```
user@host> clear oam ethernet connectivity-fault-management statistics
Cleared statistics of all CFM sessions
```

## clear oam ethernet connectivity-fault-management synthetic-loss-measurement

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>clear oam ethernet connectivity-fault-management synthetic-loss-measurement<br/>maintenance-domain <i>md-name</i><br/>maintenance-association <i>ma-name</i><br/>&lt;local-mep <i>local-mep-id</i>&gt;<br/>&lt;remote-mep <i>remote-mep-id</i>&gt;</code>                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Command introduced in Junos OS Release 13.2 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | (MX Series routers)—For all routers that support IEEE 802.1ag OAM connectivity fault management (CFM), clear the existing on-demand Ethernet synthetic loss measurement (ETH-SLM) statistics and restart counting the ETH-SLM frame counts and statistics.                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><code>maintenance-domain <i>md-name</i></code>—Name of an existing CFM maintenance domain.</p> <p><code>maintenance-association <i>ma-name</i></code>—Name of an existing CFM maintenance association.</p> <p><code>local-mep <i>local-mep-id</i></code>—(Optional) Clear connectivity fault management information for the specified local MEP only.</p> <p><code>remote-mep <i>remote-mep-id</i></code>—(Optional) Clear connectivity fault management information for the specified remote MEP only.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">monitor ethernet synthetic-loss-measurement on page 1292</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management synthetic-loss-statistics on page 1774</a></li></ul>                                                                                                                                                                                                                                                                    |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1276</a>                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                                                                                                          |

### Sample Output

`clear oam ethernet connectivity-fault-  
management synthetic-loss-  
measurement`

```
user@host> clear oam ethernet connectivity-fault-management synthetic-loss-measurement  
maintenance-domain md5 maintenance-association ma5 local-mep 100 remote-mep 102  
Synthetic loss measurement restarted.
```



## clear oam ethernet link-fault-management state

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear oam ethernet link-fault-management state < <i>interface-name</i> >                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | On all M Series, MX Series, ACX series, PTX Series, T320, and T640 routers, clear link fault management state information, restart the link discovery process, and reset OAM loopback state (if set previously) on Ethernet interfaces.                                                                                                                                                                                 |
| <b>Options</b>                  | <p><b>none</b>—Clear OAM link fault management state information, restart the link discovery process, and reset OAM loopback state (if set previously) on all Ethernet interfaces.</p> <p><b><i>interface-name</i></b>—(Optional) Clear OAM link fault management state information, restart the link discovery process, and reset OAM loopback state (if set previously) on the specified Ethernet interface only.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet link-fault-management state on page 1277</a>                                                                                                                                                                                                                                                                                                                                             |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                                   |

### Sample Output

#### clear oam ethernet link-fault-management state

```
user@host> clear oam ethernet link-fault-management state ge-0/3/3
Cleared link-fault-management state for interface ge-0/3/3
```

## clear oam ethernet link-fault-management statistics

---

|                                 |                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear oam ethernet link-fault-management < <i>interface-name</i> >                                                                                                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.2.                                                                                                                                                                                  |
| <b>Description</b>              | On M320, M120, MX Series, PTX Series, T320, and T640 routers, clear Operation, Administration, and Management (OAM) link fault management statistics or state information from Ethernet interfaces.                          |
| <b>Options</b>                  | <b>none</b> —Clear OAM link fault management statistics from all Ethernet interfaces.<br><br><b><i>interface-name</i></b> —(Optional) Clear OAM link fault management statistics from the specified Ethernet interface only. |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <a href="#">clear oam ethernet link-fault-management statistics on page 1278</a>                                                                                                                                             |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                        |

### Sample Output

#### clear oam ethernet link-fault-management statistics

```
user@host> clear oam ethernet link-fault-management statistics
Cleared link-fault-management statistics for all interfaces
```

## clear protection-group ethernet-ring statistics

|                                 |                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear protection-group ethernet-ring statistics<br><group-name <i>group-name</i> >                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4.                                                                                                                  |
| <b>Description</b>              | On MX Series routers, clear the statistics for all Ethernet ring protection groups or a specific Ethernet ring protection group.                             |
| <b>Options</b>                  | <b>group-name <i>group-name</i></b> —(Optional) Clear the Ethernet ring protection statistics for the specified group.                                       |
| <b>Required Privilege Level</b> | view                                                                                                                                                         |
| <b>List of Sample Output</b>    | <a href="#">clear protection-group ethernet-ring statistics on page 1279</a><br><a href="#">clear protection-group ethernet-ring statistics on page 1279</a> |
| <b>Output Fields</b>            | When you enter this command, you are provided feedback on the status of your request.                                                                        |

### Sample Output

#### clear protection-group ethernet-ring statistics

To clear all Ethernet ring protection group statistics for all protection groups, use the following command:

```
user@host> clear protection-group ethernet-ring statistics
```

### Sample Output

#### clear protection-group ethernet-ring statistics

To clear Ethernet ring protection group statistics for the group *my\_prot\_group*, use the following command:

```
user@host> clear protection-group ethernet-ring statistics group-name my_prot_group
```

## clear security mka statistics (MX Series)

---

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear security mka statistics<br><interface <i>interface-name</i> >                                                                                                                                                  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                     |
| <b>Description</b>              | <p>Clear—reset to zero (0)—all MACsec Key Agreement (MKA) protocol statistics.</p> <p>You are clearing the statistics that are viewed using the <b>show security mka statistics</b> when you enter this command.</p> |
| <b>Options</b>                  | <p><b>none</b>—Clear all MKA counters for all interfaces on the switch.</p> <p><b>interface <i>interface-name</i></b>—(Optional) Clear MKA traffic counters for the specified interface only.</p>                    |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                |

### Sample Output

#### clear security mka statistics

```
user@switch> clear security mka statistics
```

## clear security mka statistics (MX Series)

---

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | clear security mka statistics<br><interface <i>interface-name</i> >                                                                                                                                                  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                     |
| <b>Description</b>              | <p>Clear—reset to zero (0)—all MACsec Key Agreement (MKA) protocol statistics.</p> <p>You are clearing the statistics that are viewed using the <b>show security mka statistics</b> when you enter this command.</p> |
| <b>Options</b>                  | <p><b>none</b>—Clear all MKA counters for all interfaces on the switch.</p> <p><b>interface <i>interface-name</i></b>—(Optional) Clear MKA traffic counters for the specified interface only.</p>                    |
| <b>Required Privilege Level</b> | clear                                                                                                                                                                                                                |

## Sample Output

### clear security mka statistics

```
user@switch> clear security mka statistics
```

## monitor ethernet delay-measurement

---

**Syntax**    monitor ethernet delay-measurement  
              maintenance-domain *md-name*  
              maintenance-association *ma-name*  
              (one-way | two-way)  
              (*remote-mac-address* | mep *remote-mep-id*)  
              <count *frame-count*>  
              <local-mep *mep-id*>  
              <wait *interval-seconds*>  
              <priority *802.1p value*>  
              <size>  
              <no-session-id-tlv>  
              <xml>

**Release Information**    Command introduced in Junos OS Release 9.5.  
                              **local-mep** option introduced in Junos OS Release 15.1.

**Description**    Start an ITU-T Y.1731 Ethernet frame delay measurement session between the specified local connectivity fault management (CFM) maintenance association end point (MEP) and the specified remote MEP, and display a summary of the frames exchanged in the measurement session. Frame delay measurement statistics are stored at one of the MEPs for later retrieval.



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must type Ctrl +c to explicitly quit the **monitor ethernet delay-measurement** command and return to the CLI command prompt.

---

To start an Ethernet frame delay measurement session, the router initiates an exchange of frames carrying one-way or two-way frame delay measurement protocol data units (PDUs) between the local and remote MEPs. The frame counts—the types of and number of Ethernet frame delay measurement PDU frames exchanged to measure frame delay times—are displayed as the runtime output of the **monitor ethernet delay-measurement** command and are also stored at both the initiator and receiver MEPs for later retrieval. Ethernet frame delay measurement statistics, described below, are measured and stored at only one of the MEPs:

Frame delay—The difference, in microseconds, between the time a frame is sent and when it is received.

Frame delay variation—The difference, in microseconds, between consecutive frame delay values. Frame delay variation is sometimes called “frame jitter.”

For one-way Ethernet frame delay measurement, only the receiver MEP (on the remote system) collects statistics. For two-way Ethernet frame delay measurement, only the initiator MEP (on the local system) collects statistics.

**Options**    **maintenance-domain** *md-name*—Name of an existing CFM maintenance domain.

**maintenance-association *ma-name***—Name of an existing CFM maintenance association.

**one-way**—Measurement type is one-way Ethernet frame delay measurement, which is based on the difference between the time at which the initiator MEP sends a one-way delay measurement request (IDM) frame and the time at which the receiver MEP receives the frame.

**two-way**—Measurement type is two-way Ethernet frame delay measurement, which is based on the difference between the time at which the initiator MEP sends a two-way delay measurement message (DMM) frame and the time at which the initiator MEP receives an associated two-way delay measurement reply (DMR) frame from the responder MEP, subtracting the time elapsed at the responder MEP.

**mep *remote-mep-id***—Numeric identifier of the peer MEP with which to perform Ethernet frame delay measurement. The discovered MAC address of the peer MEP is used. The range of values is 1 through 8191.

**remote-mac-address**—Unicast MAC address of the peer MEP with which to perform Ethernet frame delay measurement. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn.nnnn.nnnn* or *nn:nn:nn:nn:nn:nn*. For example, **0011.2233.4455** or **00:11:22:33:44:55**. Multicast MAC addresses are not supported.

**count *frame-count***—(Optional) Number of frames to send to the specified peer MEP. The range of values is 1 through 65,535 frames. The default value is 10 frames.

**local-mep *mep-id***—(Required when multiple MEPs are configured) Identifier for the local maintenance association end point.

**wait *interval-seconds***—(Optional) Number of seconds to wait between sending frames. The range of values is from 1 through 255 seconds. The default value is 1 second.

**priority *802.1p value***—(Optional) Priority of the delay measurement request frame supported by both one-way delay measurement and two-way delay measurement. The range of values is from 0 through 7. The default value is zero.

**size**—(Optional) Size of the data TLV to be included in the request frame. The range of values is from 1 through 1400 bytes.

**no-session-id-tlv**—(Optional) Prevent insertion of the session ID TLV in the request frame.

**xml**—(Optional) Allow the output of the command to be displayed in XML format supported by both one-way delay measurement and two-way delay measurement. Note that the only way to get output in XML format is to use the **xml** argument. The **display xml** command does not work.

**Additional Information** To display the frame counts collected at an MEP as the result of this command, see the following command descriptions in the [CLI Explorer](#):

- **show oam ethernet connectivity-fault-management interfaces detail**
- **show oam ethernet connectivity-fault-management mep-database**

- **show oam ethernet connectivity-fault-management mep-statistics**

To display the statistics collected at an MEP as the result of this command, see the following command descriptions in the [CLI Explorer](#).

- **show oam ethernet connectivity-fault-management delay-statistics**
- **show oam ethernet connectivity-fault-management mep-statistics**

To clear both the frame counts and the statistics collected for MEPs, use the **clear oam ethernet connectivity-fault-management statistics** command, described in the [CLI Explorer](#).

For a complete description of Ethernet frame delay measurement, see the *ITU-T Y.1731 Ethernet Service OAM* topics in the *Junos OS Network Interfaces Library for Routing Devices*.

**Required Privilege Level** trace and maintenance

**List of Sample Output** [monitor ethernet delay-measurement one-way on page 1285](#)  
[monitor ethernet delay-measurement two-way on page 1286](#)  
[monitor ethernet delay-measurement two-way \(Invalid DMR Frames Received\) on page 1286](#)

**Output Fields** The **monitor ethernet delay-measurement** command displays different output at the CLI, depending on whether you start a one-way or two-way frame delay measurement:

- [Table 80 on page 1284](#) lists the run-time output fields for the **monitor ethernet delay-measurement one-way** command.
- [Table 81 on page 1285](#) lists the run-time output fields for the **monitor ethernet delay-measurement two-way** command.

Output fields are listed in the approximate order in which they appear.

**Table 80: monitor ethernet delay-measurement one-way Output Fields**

| Output Field Name         | Output Field Description                                                                       |
|---------------------------|------------------------------------------------------------------------------------------------|
| One-way ETH-DM request to | Unicast MAC address of the remote peer MEP.                                                    |
| Interface                 | Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached. |
| IDM Frames sent           | PDU frames sent to the remote MEP in this ETH-DM session.                                      |
| Packets transmitted       | Total number of IDM PDU frames sent to the remote MEP during this measurement session.         |
| Average delay             | Average two-way frame delay measured in this session.                                          |
| Average delay variation   | Average frame jitter measured in this session.                                                 |
| Best case delay           | Lowest two-way frame delay measured in this session.                                           |



Table 80: monitor ethernet delay-measurement one-way Output Fields (*continued*)

| Output Field Name       | Output Field Description                              |
|-------------------------|-------------------------------------------------------|
| <b>Worst case delay</b> | Highest two-way frame delay measured in this session. |

**NOTE:** For one-way delay measurement, these CLI output fields display **NA** ("not applicable") at the initiator MEP because one-way frame delay measurements occur at the receiver MEP.

Table 81: monitor ethernet delay-measurement two-way Output Fields

| Output Field Name                                          | Output Field Description                                                                                        |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Two-way Ethernet frame delay measurement request to</b> | Unicast MAC address of the remote peer MEP.                                                                     |
| <b>Interface</b>                                           | Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.                  |
| <b>DMR received from</b>                                   | Unicast MAC address of the remote MEP that transmitted this DMR frame in response to a DMM frame.               |
| <b>Delay</b>                                               | Two-way delay, in microseconds, for the initiator-transmitted DMM frame.                                        |
| <b>Delay variation</b>                                     | Difference, in microseconds, between the current and previous delay values. This is also known as frame jitter. |
| <b>Packets transmitted</b>                                 | Total number of DMM PDU frames sent to the remote MEP in this measurement session.                              |
| <b>Valid packets received</b>                              | Total number of DMR PDU frames received from the remote MEP in this measurement session.                        |
| <b>Average delay</b>                                       | Average two-way frame delay measured in this session.                                                           |
| <b>Average delay variation</b>                             | Average frame jitter measured in this session.                                                                  |
| <b>Best case delay</b>                                     | Lowest two-way frame delay measured in this session.                                                            |
| <b>Worst case delay</b>                                    | Highest two-way frame delay measured in this session.                                                           |

## Sample Output

### monitor ethernet delay-measurement one-way

```

user@host> monitor ethernet delay-measurement one-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
One-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
1DM Frames sent : 10
--- Delay measurement statistics ---
Packets transmitted: 10
Average delay: NA, Average delay variation: NA
Best case delay: NA, Worst case delay: NA

```

### monitor ethernet delay-measurement two-way

```
user@host> monitor ethernet delay-measurement two-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
Two-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
DMR received from 00:05:85:73:39:4a Delay: 100 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 8 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 111 usec Delay variation: 19 usec
DMR received from 00:05:85:73:39:4a Delay: 110 usec Delay variation: 1 usec
DMR received from 00:05:85:73:39:4a Delay: 119 usec Delay variation: 9 usec
DMR received from 00:05:85:73:39:4a Delay: 122 usec Delay variation: 3 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 30 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 108 usec Delay variation: 16 usec

--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 10
Average delay: 103 usec, Average delay variation: 8 usec
Best case delay: 92 usec, Worst case delay: 122 usec
```

### monitor ethernet delay-measurement two-way (Invalid DMR Frames Received)

```
user@host> monitor ethernet delay-measurement two-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
Two-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
DMR received from 00:05:85:73:39:4a Delay: 100 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 8 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 111 usec Delay variation: 19 usec
DMR received from 00:05:85:73:39:4a Delay: 110 usec Delay variation: 1 usec
DMR received from 00:05:85:73:39:4a Delay: 119 usec Delay variation: 9 usec
DMR received from 00:05:85:73:39:4a Delay: 122 usec Delay variation: 3 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 30 usec
DMR received from 00:05:85:73:39:4a with invalid timestamp(s).
DMR received from 00:05:85:73:39:4a Delay: 108 usec Delay variation: 16 usec

--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 9, Invalid packets received: 1
Average delay: 105 usec, Average delay variation: 9 usec
Best case delay: 92 usec, Worst case delay: 122 usec
```

## monitor ethernet loss-measurement

**Syntax** monitor ethernet loss-measurement  
 maintenance-domain *md-name*  
 maintenance-association *ma-name*  
 (*remote-mac-address* | mep *remote-mep-id*)  
 <count *frame-count*>  
 <local-mep *mep-id*>  
 <wait *interval-seconds*>  
 <priority *802.1p value*>  
 <no-session-id-tlv>  
 <xml>

**Release Information** Command introduced in Junos OS Release 11.1.  
**local-mep** option introduced in Junos OS Release 15.1

**Description** Start an ITU-T Y.1731 Ethernet frame loss measurement session between the specified local connectivity fault management (CFM) maintenance association end point (MEP) and the specified remote MEP, and display a count of transmitted and received data frames between the pair of MEPs. Frame loss measurement statistics are stored at one of the MEPs for later retrieval. For MX Series routers, supports point-to-point down MEPs for Ethernet interfaces (as per IEEE 802.1ag over VPWS).



**NOTE:** If you attempt to monitor loss to a nonexistent MAC address, you must type Ctrl + c to explicitly quit the **monitor ethernet loss-measurement** command and return to the CLI command prompt.

To start an Ethernet frame loss measurement session, the router first sends frames with ETH-LM information to a peer MEP and similarly receives frames with ETH-LM information from the peer MEP. Frame loss is calculated by collecting the counter values applicable for ingress and egress service frames where the counters maintain a count of transmitted and received data frames between a pair of MEPs. The loss measurement statistics are retrieved as the output of the **monitor ethernet loss-measurement** command and are also stored at the initiator. The frames counts are stored at both the initiator and the receiver MEPs for later retrieval.

**Options** **maintenance-domain** *md-name*—Name of an existing CFM maintenance domain.

**maintenance-association** *ma-name*—Name of an existing CFM maintenance association.

**mep** *remote-mep-id*—Numeric identifier of the peer MEP with which to perform Ethernet frame loss measurement. The discovered MAC address of the peer MEP is used. The range of values is from 1 through 8192.

**remote-mac-address**—Unicast MAC address of the peer MEP with which to perform Ethernet frame loss measurement. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn.nnnn.nnnn* or *nn:nn:nn:nn:nn:nn* (for

example, **0011.2233.4455** or **00:11:22:33:44:55**). Multicast MAC addresses are not supported.

**count** *frame-count*—(Optional) Number of frames to send to the specified peer MEP. The range of values is from 1 through 65535 frames. The default value is 10 frames.

**local-mep** *mep-id*—(Required when multiple MEPs are configured) Identifier for the local maintenance endpoint.

**wait** *interval-seconds*—(Optional) Number of seconds to wait between sending frames. The range of values is from 1 through 255 seconds. The default value is 1 second.

**priority** *802.1p value*—(Optional) Priority of the delay measurement request frame. The range of values is from 0 through 7. The default value is 1 second.

**no-session-id-tlv**—(Optional) Disable the **session id TLV** argument set in the request frame.

**xml**—(Optional) Allow the output of the command to be displayed in XML format.

**Additional Information** To display the iterator output for an LM session, run the following command:

- **show oam ethernet connectivity-fault-management sla-iterator-statistics sla-iterator <profile> maintenance-association <MA> maintenance-domain <MD> local-mep <MEP> remote-mep <RMEP>**

To display the frame counts collected at an MEP as the result of this command, see the following command descriptions in the [CLI Explorer](#):

- **show oam ethernet connectivity-fault-management loss-statistics**
- **show oam ethernet connectivity-fault-management interfaces detail**
- **show oam ethernet connectivity-fault-management mep-database**
- **show oam ethernet connectivity-fault-management mep-statistics**

To display the statistics collected at an MEP as the result of this command, see the following command descriptions in the [CLI Explorer](#):

- **show oam ethernet connectivity-fault-management delay-statistics**
- **show oam ethernet connectivity-fault-management mep-statistics**

To clear both the frame counts and the statistics collected for MEPs, use the **clear oam ethernet connectivity-fault-management loss-statistics maintenance-domain *md-name* maintenance-association *ma-name*** command, as described in the [CLI Explorer](#).

For a complete description of Ethernet frame loss measurement, see the *ITU-T Y.1731 Ethernet Service OAM* topics in the *Junos OS Network Interfaces Library for Routing Devices*.

**Required Privilege Level** trace and maintenance

- Related Documentation**
- [Ethernet Frame Loss Measurement Overview on page 628](#)
  - [Junos OS Network Interfaces Library for Routing Devices](#)
  - [CLI Explorer](#)

**List of Sample Output** [monitor ethernet loss-measurement on page 1290](#)

**Output Fields** [Table 82 on page 1289](#) lists the output fields for the **monitor ethernet loss-measurement** command and their descriptions. Output fields are listed in the approximate order in which they appear.

**Table 82: monitor ethernet loss-measurement output fields**

| Output Field Name                          | Output Field Description                                                                                                                                                       |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ethernet loss delay measurement request to | Unicast MAC address of the remote peer MEP.                                                                                                                                    |
| Interface                                  | Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.                                                                                 |
| LMR received from                          | Unicast MAC address of the remote MEP that transmitted this LMR frame in response to a loss measurement message (LMM) frame.                                                   |
| Near-end frame loss                        | Count of frame loss associated with ingress data frames.                                                                                                                       |
| Far-end frame loss                         | Count of frame loss associated with egress data frames.                                                                                                                        |
| Near-end loss ratio                        | Ratio, expressed as a percentage, of the number of service frames not delivered divided by the total number of service frames during time interval T at the ingress interface. |
| Far-end loss ratio                         | Ratio, expressed as a percentage, of the number of service frames not delivered divided by the total number of service frames during time interval T at the egress interface.  |
| LMM packets transmitted                    | Total number of LMM PDU frames sent to the remote MEP in this measurement session.                                                                                             |
| LMR packets received                       | Total number of LMR PDU frames received from the remote MEP in this measurement session.                                                                                       |
| Average near-end frame loss                | Average frame loss measured in this session associated with ingress data frames.                                                                                               |
| Average near-end loss ratio                | Average frame loss ratio measured in this session associated with ingress data frames.                                                                                         |
| Average far-end frame loss                 | Average frame loss measured in this session associated with egress data frames.                                                                                                |
| Average far-end loss ratio                 | Average frame loss ratio measured in this session associated with egress data frames.                                                                                          |
| Near-end best case frame loss              | Lowest frame loss measured in this session associated with ingress data frames.                                                                                                |
| Near-end best case loss ratio              | Lowest frame loss ratio measured in this session associated with ingress data frames.                                                                                          |

Table 82: monitor ethernet loss-measurement output fields (*continued*)

| Output Field Name              | Output Field Description                                                               |
|--------------------------------|----------------------------------------------------------------------------------------|
| Near-end worst case frame loss | Highest frame loss measured in this session associated with ingress data frames.       |
| Near-end worst case loss ratio | Highest frame loss ratio measured in this session associated with ingress data frames. |
| Far-end best case frame loss   | Lowest frame loss measured in this session associated with egress data frames.         |
| Far-end best case loss ratio   | Lowest frame loss ratio measured in this session associated with egress data frames.   |
| Far-end worst case frame loss  | Highest frame loss measured in this session associated with egress data frames.        |
| Far-end worst case loss ratio  | Highest frame loss ratio measured in this session associated with egress data frames.  |

Note that in the preceding table, the term *number of service frames not delivered* is the difference between the number of service frames arriving at the ingress Ethernet flow point and the number of service frames delivered at the egress Ethernet flow point in a point-to-point Ethernet connection.

## Sample Output

### monitor ethernet loss-measurement

```

user@host> monitor ethernet loss-measurement mep 2 64:87:88:6a:da:94 maintenance-domain
md maintenance-association ma count 10
ETH-LM request to 64:87:88:6a:da:94, Interface ge-2/3/2.0

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):0
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.00000%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):260
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.43537%

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):1
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.51546%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):257
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.31615%

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):0
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.00000%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):261
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.77551%

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):0
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.00000%

```

```

Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):260
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.43537%

```

```

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):1
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.51020%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):259
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.09524%

```

```

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):0
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.00000%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):519
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.71795%

```

```

LMR received from 64:87:88:6a:da:94
Near-end frame loss(CIR)      :0          Far-end frame loss(CIR):1
Near-end frame loss ratio(CIR):0.00000% Far-end frame loss ratio(CIR):0.51020%
Near-end frame loss(EIR)      :0          Far-end frame loss(EIR):259
Near-end frame loss ratio(EIR):0.00000% Far-end frame loss ratio(EIR):88.09524%

```

```

--- Loss measurement statistics ---
LMM packets transmitted: 10, Valid LMR packets received: 8
Average near-end loss(CIR)      : 0.00000
Average near-end loss ratio(CIR) : 0.00000%
Average far-end loss(CIR)       : 0.42857
Average far-end loss ratio(CIR) : 0.21941%
Near-end best case loss(CIR)    : 0
Near-end best case loss ratio(CIR): 0.00000%
Near-end worst case loss(CIR)   : 0
Near-end worst case loss ratio(CIR): 0.00000%
Far-end best case loss(CIR)     : 0
Far-end best case loss ratio(CIR) : 0.00000%
Far-end worst case loss(CIR)    : 1
Far-end worst case loss ratio(CIR): 0.51546%
Average near-end loss(EIR)      : 0.00000
Average near-end loss ratio(EIR) : 0.00000%
Average far-end loss(EIR)       : 296.42857
Average far-end loss ratio(EIR) : 88.41011%
Near-end best case loss(EIR)    : 0
Near-end best case loss ratio(EIR): 0.00000%
Near-end worst case loss(EIR)   : 0
Near-end worst case loss ratio(EIR): 0.00000%
Far-end best case loss(EIR)     : 257
Far-end best case loss ratio(EIR) : 88.09524%
Far-end worst case loss(EIR)    : 519
Far-end worst case loss ratio(EIR) : 88.77551%

```

## monitor ethernet synthetic-loss-measurement

**Syntax** monitor ethernet synthetic-loss-measurement  
 maintenance-domain *md-name*  
 maintenance-association *ma-name*  
 (*remote-mac-address* | mep *remote-mep-id*)  
 <count *frame-count*>  
 <local-mep *mep-id*>  
 <wait *interval-milliseconds*>  
 <priority *802.1p value*>  
 <size>  
 <xml>

**Release Information** Command introduced in Junos OS Release 13.2 for MX Series routers.  
**local-mep** option introduced in Junos OS Release 15.1

**Description** (MX Series routers) Start an ITU-T Y.1731 Ethernet synthetic loss measurement (ETH-SLM) session between the specified local connectivity fault management (CFM) maintenance association end point (MEP) and the specified remote MEP, and display a summary of the frames exchanged in the measurement session. ETH-SLM (also called synthetic frame loss measurement) statistics are stored at one of the MEPs for later retrieval.



**NOTE:** If you attempt to monitor delays to a nonexistent MAC address, you must press Ctrl +c to explicitly quit the **monitor ethernet synthetic-loss-measurement** command and return to the CLI command prompt.

To start an Ethernet synthetic frame loss measurement session, the router initiates an exchange of frames carrying synthetic frame loss measurement protocol data units (PDUs) between the local and remote MEPs. The frame counts—the types of and number of Ethernet synthetic frame loss measurement PDU frames exchanged to measure frame delay times—are displayed as the run-time output of the **monitor ethernet synthetic-loss-measurement** command and are also stored at both the initiator and receiver MEPs for later retrieval. Ethernet synthetic frame loss measurement statistics, described below, are measured and stored at only one of the MEPs:

Frame delay—The difference, in microseconds, between the time a frame is sent and when it is received.

Frame delay variation—The difference, in microseconds, between consecutive frame delay values. Frame delay variation is sometimes called “frame jitter.”

**Options** **maintenance-domain** *md-name*—Name of an existing CFM maintenance domain.  
**maintenance-association** *ma-name*—Name of an existing CFM maintenance association.



**mep remote-mep-id**—Numeric identifier of the peer MEP with which to perform Ethernet synthetic frame loss measurement. The discovered MAC address of the peer MEP is used. The range of values is from 1 through 8191.

**remote-mac-address**—Unicast MAC address of the peer MEP with which to perform Ethernet synthetic frame loss measurement. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn.nnnn.nnnn* or *nn:nn:nn:nn:nn:nn*. For example, **0011.2233.4455** or **00:11:22:33:44:55**. Multicast MAC addresses are not supported.

**count frame-count**—(Optional) Number of frames to send to the specified peer MEP. The range of values is from 1 through 65,535 frames. The default value is 10 frames.

**local-mep mep-id**—(Required when multiple MEPs are configured) Identifier for the local maintenance endpoint.

**wait interval-milliseconds**—(Optional) Number of milliseconds to wait between sending frames. You must specify this value in multiples of 100 milliseconds. The range of values is from 100 through 50000 milliseconds. The default value is 100 milliseconds.

**priority 802.1p value**—(Optional) Priority of the ETH-SLM request frame supported. The range of values is from 0 through 7. The default value is zero.

**size**—(Optional) Size of the data TLV to be included in the request frame. The range of values is from 1 through 1400 bytes.

**xml**—(Optional) Allow the output of the command to be displayed in XML format for ETH-SLM. Note that the only way to get output in XML format is to use the **xml** argument. The **display xml** command does not work.

**Additional Information** To display the frame counts collected at a MEP as the result of this command, use the following commands as described in the [CLI Explorer](#):

- **show oam ethernet connectivity-fault-management interfaces detail**
- **show oam ethernet connectivity-fault-management mep-database**
- **show oam ethernet connectivity-fault-management mep-statistics**

To display the statistics collected at a MEP as the result of this command, use the following commands as described in the [CLI Explorer](#).

- **show oam ethernet connectivity-fault-management synthetic-loss-measurement**
- **show oam ethernet connectivity-fault-management mep-statistics**

To clear both the frame counts and the statistics collected for MEPs, use the **clear oam ethernet connectivity-fault-management statistics** command, described in the [CLI Explorer](#).

For a complete description of Ethernet synthetic frame loss measurement, see the *ITU-T Y.1731 Ethernet Service OAM* topics in the *Junos OS Network Interfaces Library for Routing Devices*.

**Required Privilege Level** trace and maintenance

**Related Documentation**

- [clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1276](#)
- [monitor ethernet synthetic-loss-measurement on page 1292](#)
- [show oam ethernet connectivity-fault-management loss-statistics on page 1738](#)

**List of Sample Output** [monitor ethernet synthetic-loss-measurement on page 1295](#)

**Output Fields** The **monitor ethernet synthetic-loss-measurement** command displays different output at the CLI, depending on when you start a synthetic frame loss measurement:

- [Table 83 on page 1294](#) lists the run-time output fields for the **monitor ethernet synthetic-loss-measurement** command.

Output fields are listed in the approximate order in which they appear.

**Table 83: monitor ethernet synthetic-loss-measurement Output Fields**


| Output Field Name                        | Output Field Description                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ETH-SLM request to</b>                | Unicast MAC address of the remote peer MEP.                                                                                                                                                                                                                                                                                       |
| <b>Interface</b>                         | Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.                                                                                                                                                                                                                                    |
| <b>SLM packets sent</b>                  | Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.                                                                                                                                                                                                   |
| <b>SLR packets received</b>              | Total number of synthetic loss reply (SLR) PDU frames received by the source MEP from the remote MEP during this measurement session.                                                                                                                                                                                             |
| <b>Local TXFCI value</b>                 | Number of synthetic frames transmitted to the peer MEP for a test ID. A test ID is used to distinguish each synthetic loss measurement because multiple measurements can be simultaneously activated also on a given CoS and MEP pair. It must be unique at least within the context of any SLM for the MEG and initiating MEP.   |
| <b>Local RXFCI value</b>                 | Number of synthetic frames received from the peer MEP for a test ID. The MEP generates a unique test ID for the session, adds the source MEP ID, and initializes the local counters for the session before SLM initiation. For each SLM PDU transmitted for the session (test ID), the local counter TXFCI is sent in the packet. |
| <b>Last Received SLR frame TXFCf(tc)</b> | Value of the local counter TxFCI at the time of SLM frame transmission.                                                                                                                                                                                                                                                           |
| <b>Last Received SLR frame TXFCb(t)</b>  | Value of the local counter RxFCI at the time of SLR frame transmission.                                                                                                                                                                                                                                                           |
| <b>Frame loss (near-end)</b>             | Count of frame loss associated with ingress data frames.                                                                                                                                                                                                                                                                          |
| <b>Frame loss (far-end)</b>              | Count of frame loss associated with egress data frames.                                                                                                                                                                                                                                                                           |

## Sample Output

### monitor ethernet synthetic-loss-measurement

```
user@host> monitor ethernet synthetic-loss-measurement 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
ETH-SLM request to 00:05:85:73:39:4a, interface ge-1/0/0.0
  Synthetic Loss measurement statistics:
    SLM packets sent                : 100
    SLR packets received             : 100
    Accumulated SLM statistics:
      Local TXFC1 value              : 100
      Local RXFC1 value              : 100
      Last Received SLR frame TXFCf(tc) : 100
      Last Received SLR frame TXFCb(tc) : 100
    SLM Frame Loss:
      Frame Loss (far-end)            : 0 (0.00 %)
      Frame Loss (near-end)           : 0 (0.00 %)
```

## request interface mc-ae switchover (Multichassis Link Aggregation)

|                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                      | request interface mc-ae switchover<br><immediate> mcae-id <i>mcae-id</i> ;<br>mcae-id <i>mcae-id</i> ;                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>                                                                                                                                                                                                                                                         | Command introduced in Junos OS Release 13.3.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>                                                                                                                                                                                                                                                                 | Manually revert egress traffic from the active node to the designated preferred node of a multichassis aggregated Ethernet interface. You can use this command to manually switch over traffic to the preferred node when the <b>switchover-mode</b> statement for the multichassis aggregated Ethernet interface is configured as <b>non-revertive</b> at the <b>[edit interfaces aeX mc-ae]</b> hierarchy level. |
| <div>  <b>NOTE:</b> To run this command successfully, the <b>status-control</b> statement should be configured as <b>active</b> at the <b>[edit interfaces aeX mc-ae]</b> hierarchy level. </div> |                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                                                                                                                                                                                                                                                                     | <p><b>immediate</b>—(Optional) Trigger immediate switchover to the preferred node. If this option is not configured, Junos OS waits for the timer configured using the <b>revert-time</b> statement at the <b>[edit interfaces aeX mc-ae]</b> hierarchy level to expire before it triggers the switchover.</p> <p><b>mcae-id <i>mcae-id</i></b>—Triggers switchover for the specified mc-ae interface.</p>         |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                    | view                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Related Documentation</b>                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li><i>Configuring Multichassis Link Aggregation on MX Series Routers</i></li> <li><i>Configuring Manual and Automatic Link Switchover for MC-LAG Interfaces</i></li> </ul>                                                                                                                                                                                                     |
| <b>List of Sample Output</b>                                                                                                                                                                                                                                                       | <a href="#">request interface mc-ae switchover immediate mcae-id on page 1296</a><br><a href="#">request interface mc-ae switchover mcae-id on page 1296</a>                                                                                                                                                                                                                                                       |
| <b>Output Fields</b>                                                                                                                                                                                                                                                               | When you enter this command, you are provided feedback on the status of your request.                                                                                                                                                                                                                                                                                                                              |

### Sample Output

request interface mc-ae switchover immediate mcae-id

```
user@host >request interface mc-ae switchover immediate mcae-id 2
MCAE: Switchover Done
```

### Sample Output

request interface mc-ae switchover mcae-id

```
user@host >request interface mc-ae switchover mcae-id 2
```

Switchover In Progress: Please check after 1 minutes,  
Use “show interfaces mc-ae revertive-info” to check for the status

## request interface (revert | switchover) (Aggregated Ethernet Link Protection)

**Syntax** request interface (revert | switchover) aex

**Release Information** Command introduced in Junos OS Release 8.3.

**Description** Manually revert egress traffic from the designated backup link to the designated primary link of an aggregated Ethernet interface for which link protection is enabled, or manually switch egress traffic from the primary link to the backup link. This traffic includes transit traffic and local traffic originated on the router itself.



**NOTE:** When link protection is enabled on an aggregated Ethernet interface, if the primary link fails, the router automatically routes egress traffic to the backup link. However, the router does not automatically route egress traffic back to the primary link when the primary link is subsequently reestablished. Instead, you manually control when to have traffic diverted back to the primary link by issuing the `request interface (revert | switchover) (Aggregated Ethernet Link Protection)` operational command and specifying the `revert` keyword.

On M Series and T Series routers, use the `request interface (revert | switchover) (Adaptive Services)` operational command to manually revert to the primary adaptive services interface or link services interface, or to switch from the primary to the secondary interface. For information about this command, see *request interface (revert | switchover) (Adaptive Services)*.

**Options** `revert`—Restores egress traffic processing to the primary link.

`switchover`—Transfers egress traffic processing to the secondary (backup) link.

`aex`—Aggregated Ethernet logical interface number: 0 through 15.

**Required Privilege Level** view

**List of Sample Output** [request interface revert on page 1298](#)


**Output Fields** When you enter this command, you are provided feedback on the status of your request.

### Sample Output

`request interface revert`

```
user@host >request interface revert ael
```

## request lacp link-switchover

|                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | request lacp link-switchover aex                                                                                                                           |
| <b>Release Information</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | Command introduced in Junos OS Release 9.3.                                                                                                                |
| <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | Manually switch aggregated Ethernet active or standby LACP links.                                                                                          |
| <div>  <p><b>NOTE:</b> Because this command overrides LACP priority calculations, we strongly recommend that you use this command only when the actor (in this case, the Juniper Networks router) is controlling the active or standby link and the partner (peer) is following. This scenario occurs when you configure only the actor for link protection.</p> </div> |                                                                                                                                                            |
| <b>Options</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           | aex—Aggregated Ethernet logical interface number: 0 through 15.                                                                                            |
| <b>Required Privilege Level</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | view                                                                                                                                                       |
| <b>List of Sample Output</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | <a href="#">request lacp link-switchover aeX on page 1299</a>                                                                                              |
| <b>Output Fields</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | When you enter this command, you are provided feedback on the status of your request. To view the switchover, use the <b>show lacp interfaces</b> command. |

## Sample Output

### request lacp link-switchover aeX

```
user@host >request lacp link-switchover ae0ae0: Request succeeded
```

## show chassis hardware

---

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>List of Syntax</b>                     | <a href="#">Syntax on page 1300</a><br><a href="#">Syntax (EX Series) on page 1300</a><br><a href="#">Syntax (T4000 Router) on page 1300</a><br><a href="#">Syntax (TX Matrix Router) on page 1300</a><br><a href="#">Syntax (TX Matrix Plus Router) on page 1300</a><br><a href="#">Syntax (MX Series Routers) on page 1300</a><br><a href="#">Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers) on page 1300</a><br><a href="#">Syntax (QFX Series) on page 1301</a><br><a href="#">Syntax (OCX Series) on page 1301</a><br><a href="#">Syntax (PTX Series Packet Transport Routers) on page 1301</a><br><a href="#">Syntax (ACX Series Universal Access Routers) on page 1301</a> |
| <b>Syntax</b>                             | <code>show chassis hardware</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;models&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Syntax (EX Series)</b>                 | <code>show chassis hardware</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;models&gt;</code><br><code>&lt;satellite [slot-id <i>slot-id</i>   device-alias <i>alias-name</i>]&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Syntax (T4000 Router)</b>              | <code>show chassis hardware</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;models&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Syntax (TX Matrix Router)</b>          | <code>show chassis hardware</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;models&gt;</code><br><code>&lt;lcc <i>number</i>   scc&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Syntax (TX Matrix Plus Router)</b>     | <code>show chassis hardware</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;models&gt;</code><br><code>&lt;lcc <i>number</i>   sfc <i>number</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Syntax (MX Series Routers)</b>         | <code>show chassis hardware</code><br><code>&lt;detail   extensive&gt;</code><br><code>&lt;clei-models&gt;</code><br><code>&lt;models&gt;</code><br><code>&lt;all-members&gt;</code><br><code>&lt;local&gt;</code><br><code>&lt;member <i>member-id</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Syntax (MX104, MX2010, and MX2020)</b> | <code>show chassis hardware</code><br><code>&lt;clei-models&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



|                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3D Universal Edge Routers)                   | <detail   extensive><br><models><br><satellite [slot-id <i>slot-id</i>   device-alias <i>alias-name</i> ]>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Syntax (QFX Series)                          | show chassis hardware<br><detail   extensive><br><clei-models><br><interconnect-device <i>name</i> ><br><node-device <i>name</i> ><br><models>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Syntax (OCX Series)                          | show chassis hardware<br><detail   extensive><br><clei-models><br><models>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Syntax (PTX Series Packet Transport Routers) | show chassis hardware<br><detail   extensive><br><clei-models><br><models>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Syntax (ACX Series Universal Access Routers) | show chassis hardware<br><detail   extensive><br><clei-models><br><models>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Release Information                          | <p>Command introduced before Junos OS Release 7.4.</p> <p><b>models</b> option introduced in Junos OS Release 8.2.</p> <p>Command introduced in Junos OS Release 9.0 for EX Series switches.</p> <p><b>sfc</b> option introduced for the TX Matrix Plus router in Junos OS Release 9.6.</p> <p>Command introduced in Junos OS Release 11.1 for QFX Series.</p> <p>Command introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.</p> <p>Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.</p> <p>Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p> <p><b>satellite</b> option introduced in Junos OS Release 14.2R3.</p> |
| Description                                  | <p>Display a list of all Flexible PIC Concentrators (FPCs) and PICs installed in the router or switch chassis, including the hardware version level and serial number.</p> <p>In the EX Series switch command output, FPC refers to the following:</p> <ul style="list-style-type: none"> <li>On EX2200 switches, EX3200 switches, EX4200 standalone switches, and EX4500 switches—Refers to the switch; FPC <i>number</i> is always 0.</li> <li>On EX4200 switches in a Virtual Chassis configuration—Refers to the member of a Virtual Chassis; FPC <i>number</i> equals the member ID, from 0 through 9.</li> <li>On EX8208 and EX8216 switches—Refers to a line card; FPC <i>number</i> equals the slot number for the line card.</li> </ul>                                                                                                                                                                                                                                        |

On QFX3500, QFX5100, OCX Series standalone switches, and PTX1000 routers, both the FPC and FPC *number* are always 0.

On T4000 Type 5 FPCs, there are no **top temperature sensor** or **bottom temperature sensor** parameters. Instead, **fan intake temperature sensor** and **fan exhaust temperature sensors** parameters are displayed.

Starting from Junos OS Release 11.4, the output of the **show chassis hardware models** operational mode command displays the enhanced midplanes FRU model numbers (CHAS-BP3-MX240-S, CHAS-BP3-MX480-S or CHAS-BP3-MX960-S) based on the router. Prior to release 11.4, the FRU model numbers are left blank when the router has enhanced midplanes. Note that the enhanced midplanes are introduced through the Junos OS Release 13.3, but can be supported on all Junos OS releases.

Starting with Junos OS Release 14.1, the output of the **show chassis hardware detail | extensive | clei-models | models** operational mode command displays the new DC power supply module (PSM) and power distribution unit (PDU) that are added to provide power to the high-density FPC (FPC2-PTX-P1A) and other components in a PTX5000 Packet Transport Router.

- Options** **none**—Display information about hardware. For a TX Matrix router, display information about the TX Matrix router and its attached T640 routers. For a TX Matrix Plus router, display information about the TX Matrix Plus router and its attached routers.
- clei-models**—(Optional) Display Common Language Equipment Identifier (CLEI) barcode and model number for orderable field-replaceable units (FRUs).
- detail**—(Optional) Include RAM and disk information in output.
- extensive**—(Optional) Display ID EEPROM information.
- all-members**—(MX Series routers only) (Optional) Display hardware-specific information for all the members of the Virtual Chassis configuration.
- interconnect-device name**—(QFabric systems only) (Optional) Display hardware-specific information for the Interconnect device.
- lcc number**—(TX Matrix routers and TX Matrix Plus router only) (Optional) On a TX Matrix router, display hardware information for a specified T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display hardware information for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.
- Replace *number* with the following values depending on the LCC configuration:
- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
  - 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.

- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

**local**—(MX Series routers only) (Optional) Display hardware-specific information for the local Virtual Chassis members.

**member *member-id***—(MX Series routers and EX Series switches) (Optional) Display hardware-specific information for the specified member of the Virtual Chassis configuration. Replace *member-id* variable with a value 0 or 1.

**models**—(Optional) Display model numbers and part numbers for orderable FRUs and, for components that use ID EEPROM format v2, the CLEI code.

**node-device *name***—(QFabric systems only) (Optional) Display hardware-specific information for the Node device.

**satellite [*slot-id slot-id* | device-alias *alias-name*]**—(Junos Fusion only) (Optional) Display hardware information for the specified satellite device in a Junos Fusion, or for all satellite devices in the Junos Fusion if no satellite devices are specified.

**scc**—(TX Matrix router only) (Optional) Display hardware information for the TX Matrix router (switch-card chassis).

**sfc *number***—(TX Matrix Plus router only) (Optional) Display hardware information for the TX Matrix Plus router (switch-fabric chassis). Replace *number* variable with 0.

**Additional Information** The **show chassis hardware detail** command now displays DIMM information for the following Routing Engines:

**Table 84: Routing Engines Displaying DIMM Information**

| Routing Engines             | Routers                         |
|-----------------------------|---------------------------------|
| RE-S-1800x2 and RE-S-1800x4 | MX240, MX480, and MX960 routers |
| RE-A-1800x2                 | M120 and M320 routers           |

In Junos OS Release 11.4 and later, the output for the **show chassis hardware models** operational mode command for MX Series routers display the enhanced midplanes FRU model numbers—CHAS-BP3-MX240-S, CHAS-BP3-MX480-S, or CHAS-BP3-MX960-S—based on the router. In releases before Junos OS Release 11.4, the FRU model numbers are left blank when the router has enhanced midplanes. Note that the enhanced midplanes are introduced through Junos OS Release 13.3, but can be supported on all Junos OS releases.

**Required Privilege Level** view

**Related Documentation**

- *show chassis power*

**List of Sample Output**

- [show chassis hardware \(EX8216 Switch\) on page 1310](#)
- [show chassis hardware clei-models \(EX8216 Switch\) on page 1311](#)
- [show chassis hardware clei-models \(T1600 Router\) on page 1312](#)
- [show chassis hardware \(EX2300-C Switch\) on page 1313](#)
- [show chassis hardware \(EX2300 Switch\) on page 1313](#)
- [show chassis hardware detail \(EX4200 Switch\) on page 1313](#)
- [show chassis hardware \(EX4300 Switch\) on page 1313](#)
- [show chassis hardware models \(EX4500 Switch\) on page 1314](#)
- [show chassis hardware detail \(EX9200 Switch\) on page 1314](#)
- [show chassis hardware \(M7i Router\) on page 1315](#)
- [show chassis hardware \(M10 Router\) on page 1315](#)
- [show chassis hardware models \(M10 Router\) on page 1316](#)
- [show chassis hardware \(M20 Router\) on page 1316](#)
- [show chassis hardware models \(M20 Router\) on page 1317](#)
- [show chassis hardware \(M40 Router\) on page 1317](#)
- [show chassis hardware \(M40e Router\) on page 1318](#)
- [show chassis hardware \(M120 Router\) on page 1318](#)
- [show chassis hardware detail \(M120 Router\) on page 1319](#)
- [show chassis hardware models \(M120 Router\) on page 1320](#)
- [show chassis hardware \(M160 Router\) on page 1321](#)
- [show chassis hardware models \(M160 Router\) on page 1321](#)
- [show chassis hardware detail \(M160 Router\) on page 1322](#)
- [show chassis hardware \(M320 Router\) on page 1323](#)
- [show chassis hardware models \(M320 Router\) on page 1324](#)
- [show chassis hardware \(MX5 Router\) on page 1325](#)
- [show chassis hardware \(MX10 Router\) on page 1325](#)
- [show chassis hardware \(MX40 Router\) on page 1326](#)
- [show chassis hardware \(Fixed MX80 Router\) on page 1326](#)
- [show chassis hardware \(Modular MX80 Router\) on page 1327](#)
- [show chassis hardware \(MX104 Router\) on page 1327](#)
- [show chassis hardware detail \(MX104 Router\) on page 1328](#)
- [show chassis hardware extensive \(MX104 Router\) on page 1328](#)
- [show chassis hardware models \(MX104 Router\) on page 1332](#)
- [show chassis hardware clei-models \(MX104 Router\) on page 1332](#)
- [show chassis hardware \(MX240 Router\) on page 1332](#)
- [show chassis hardware detail \(MX 240 Router with Routing Engine Displaying DIMM Information\) on page 1333](#)
- [show chassis hardware \(MX240 Router with Enhanced MX SCB\) on page 1333](#)
- [show chassis hardware \(MX480 Router\) on page 1334](#)
- [show chassis hardware \(MX480 Router with Enhanced MX SCB\) on page 1334](#)
- [show chassis hardware \(MX480 Routers with MPC5E and Built-in OTN PIC\) on page 1335](#)
- [show chassis hardware detail \(MX480 Routers with MPC5E and Built-in OTN PIC\) on page 1336](#)
- [show chassis hardware extensive \(MX480 Routers with MPC5E and Built-in OTN PIC\) on page 1338](#)
- [show chassis hardware \(MX960 Router\) on page 1341](#)

[show chassis hardware \(MX960 Router with Bidirectional Optics\) on page 1341](#)  
[show chassis hardware \(MX960 Router with Enhanced MX SCB\) on page 1342](#)  
[show chassis hardware models \(MX960 Router with Enhanced MX SCB\) on page 1344](#)  
[show chassis hardware \(MX960 Router with MPC5EQ\) on page 1344](#)  
[show chassis hardware detail \(MX960 Router\) on page 1347](#)  
[show chassis hardware detail \(MX960 Router with MPC5EQ\) on page 1348](#)  
[show chassis hardware extensive \(MX960 Router with MPC5EQ\) on page 1351](#)  
[show chassis hardware models \(MX960 Router with MPC5EQ\) on page 1359](#)  
[show chassis hardware clei-models \(MX960 Router with MPC5EQ\) on page 1360](#)  
[show chassis hardware \(MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC\) on page 1360](#)  
[show chassis hardware clei-models \(MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC\) on page 1361](#)  
[show chassis hardware \(PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC\) on page 1362](#)  
[show chassis hardware clei-models \(PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC\) on page 1362](#)  
[show chassis hardware \(MX2010 Router\) on page 1363](#)  
[show chassis hardware detail \(MX2010 Router\) on page 1365](#)  
[show chassis hardware extensive \(MX2010 Router\) on page 1370](#)  
[show chassis hardware models \(MX2010 Router\) on page 1375](#)  
[show chassis hardware clei-models \(MX2010 Routers\) on page 1376](#)  
[show chassis hardware \(MX2010 Routers with MPC6E and OTN MIC\) on page 1377](#)  
[show chassis hardware detail \(MX2010 Routers with MPC6E and OTN MIC\) on page 1379](#)  
[show chassis hardware extensive \(MX2010 Routers with MPC6E and OTN MIC\) on page 1380](#)  
[show chassis hardware \(MX2020 Router\) on page 1385](#)  
[show chassis hardware detail \(MX2020 Router\) on page 1394](#)  
[show chassis hardware models \(MX2020 Router\) on page 1403](#)  
[show chassis hardware clei-models \(MX2020 Router\) on page 1404](#)  
[show chassis hardware \(MX2020 Router with MPC5EQ and MPC6E\) on page 1405](#)  
[show chassis hardware detail \(MX2020 Router with MPC5EQ and MPC6E\) on page 1410](#)  
[show chassis hardware extensive \(MX2020 Router with MPC5EQ and MPC6E\) on page 1411](#)  
[show chassis hardware models \(MX2020 Routers with MPC5EQ and MPC6E\) on page 1417](#)  
[show chassis hardware clei-models \(MX2020 Router with MPC5EQ and MPC6E\) on page 1418](#)  
[show chassis hardware \(MX Series routers with ATM MIC\) on page 1419](#)  
[show chassis hardware \(MX240, MX480, MX960 routers with Application Services Modular Line Card\) on page 1420](#)  
[show chassis hardware extensive \(MX240, MX480, MX960 Routers with Application Services Modular Line Card\) on page 1420](#)  
[show chassis hardware \(MX480 Router with MPC4E\) on page 1421](#)  
[show chassis hardware \(MX2020 Router with MPC4E\) on page 1422](#)  
[show chassis hardware \(MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC\) on page 1424](#)  
[show chassis hardware models \(MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC\) on page 1425](#)

[show chassis hardware \(T320 Router\) on page 1425](#)  
[show chassis hardware \(T640 Router\) on page 1426](#)  
[show chassis hardware models \(T640 Router\) on page 1427](#)  
[show chassis hardware extensive \(T640 Router\) on page 1427](#)  
[show chassis hardware \(T4000 Router\) on page 1428](#)  
[show chassis hardware \(T4000 Router with 16-GB Line Card Chassis \(LCC\) Routing Engine\) on page 1430](#)  
[show chassis hardware \(T4000 Router with LSR FPC\) on page 1430](#)  
[show chassis hardware clei-models \(T4000 Router\) on page 1431](#)  
[show chassis hardware detail \(T4000 Router\) on page 1431](#)  
[show chassis hardware models \(T4000 Router\) on page 1433](#)  
[show chassis hardware lcc \(TX Matrix Router\) on page 1434](#)  
[show chassis hardware scc \(TX Matrix Router\) on page 1434](#)  
[show chassis hardware \(T1600 Router\) on page 1435](#)  
[show chassis hardware \(TX Matrix Plus Router\) on page 1437](#)  
[show chassis hardware sfc \(TX Matrix Plus Router\) on page 1442](#)  
[show chassis hardware extensive \(TX Matrix Plus Router\) on page 1443](#)  
[show chassis hardware clei-models \(TX Matrix Plus Router\) on page 1444](#)  
[show chassis hardware detail \(TX Matrix Plus Router\) on page 1447](#)  
[show chassis hardware models \(TX Matrix Plus Router\) on page 1448](#)  
[show chassis hardware \(TX Matrix Plus Router with 3D SIBs\) on page 1451](#)  
[show chassis hardware clei-models \(TX Matrix Plus Router with 3D SIBs\) on page 1455](#)  
[show chassis hardware detail \(TX Matrix Plus Router with 3D SIBs\) on page 1459](#)  
[show chassis hardware lcc \(TX Matrix Plus Router with 3D SIBs\) on page 1462](#)  
[show chassis hardware sfc \(TX Matrix Plus Router with 3D SIBs\) on page 1463](#)  
[show chassis hardware \(16-Port 10-Gigabit Ethernet MPC with SFP+ Optics \[MX Series Routers\]\) on page 1464](#)  
[show chassis hardware \(MPC3E \[MX Series Routers\]\) on page 1465](#)  
[show chassis hardware \(QFX3500 Switches\) on page 1466](#)  
[show chassis hardware detail \(QFX3500 Switches\) on page 1466](#)  
[show chassis hardware models \(QFX3500 Switches\) on page 1468](#)  
[show chassis hardware clei-models \(QFX3500 Switches\) on page 1468](#)  
[show chassis hardware clei-models \(QFX5100 Switches\) on page 1468](#)  
[show chassis hardware interconnect-device \(QFabric Systems\) on page 1468](#)  
[show chassis hardware node-device \(QFabric Systems\) on page 1468](#)  
[show chassis hardware \(PTX5000 Packet Transport Router\) on page 1468](#)  
[show chassis hardware \(PTX5000 Packet Transport Router with AC PSM and PDU\) on page 1470](#)  
[show chassis hardware \(PTX5000 Packet Transport Router with FPC2-PTX-P1A\) on page 1470](#)  
[show chassis hardware clei-models \(PTX5000 Packet Transport Router\) on page 1471](#)  
[show chassis hardware clei-models \(PTX5000 Packet Transport Router with AC PSM and PDU\) on page 1471](#)  
[show chassis hardware clei-models \(PTX5000 Packet Transport Router with FPC2-PTX-P1A\) on page 1472](#)  
[show chassis hardware detail \(PTX5000 Packet Transport Router\) on page 1472](#)  
[show chassis hardware detail \(PTX5000 Packet Transport Router with AC PSM and PDU\) on page 1474](#)

[show chassis hardware detail \(PTX5000 Packet Transport Router with FPC2-PTX-P1A\) on page 1474](#)  
[show chassis hardware models \(PTX5000 Packet Transport Router\) on page 1474](#)  
[show chassis hardware models \(PTX5000 Packet Transport Router with AC PSM and PDU\) on page 1475](#)  
[show chassis hardware models \(PTX5000 Packet Transport Router with FPC2-PTX-P1A\) on page 1475](#)  
[show chassis hardware extensive \(PTX5000 Packet Transport Router\) on page 1476](#)  
[show chassis hardware extensive \(PTX1000 Packet Transport Router\) on page 1477](#)  
[show chassis hardware \(MX Routers with Media Services Blade \[MSB\]\) on page 1477](#)  
[show chassis hardware extensive \(MX Routers with Media Services Blade \[MSB\]\) on page 1477](#)  
[show chassis hardware \(QFX3500 Switch running Enhanced Layer 2 Software\) on page 1479](#)  
[show chassis hardware \(QFX5100 Switch running Enhanced Layer 2 Software\) on page 1479](#)

**Output Fields** [Table 85 on page 1308](#) lists the output fields for the **show chassis hardware** command. Output fields are listed in the approximate order in which they appear.

Table 85: show chassis hardware Output Fields

| Field Name           | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Item</b>          | <p>Chassis component:</p> <ul style="list-style-type: none"> <li>(EX Series switches)—Information about the chassis, Routing Engine (SRE and Routing Engine modules in EX8200 switches), power supplies, fan trays, and LCD panel. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs). Information about the backplane, midplane, and SIBs (SF modules) is displayed for EX8200 switches. See <i>EX Series Switches Hardware and CLI Terminology Mapping</i>.</li> <li>(MX Series routers and EX Series switches)—Information about the backplane, Routing Engine, Power Entry Modules (PEMs), and fan trays. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs), Modular Port Concentrators (MPCs) and associated Modular Interface Cards (MICs), or Dense Port Concentrators (DPCs). MX80 routers have a single Routing Engine and a built-in Packet Forwarding Engine that attaches directly to MICs. The Packet Forwarding Engine has two “pseudo” FPCs (FPC 0 and FPC1). MX80 routers also have a Forwarding Engine Board (FEB). MX104 routers have a built-in Packet forwarding Engine and a Forwarding Engine Board (FEB). The Packet Forwarding Engine of the MX104 router has three “pseudo” FPCs (FPC0, FPC1, and FPC2).</li> <li>(M Series routers, except for the M320 router)—Information about the backplane; power supplies; fan trays; Routing Engine; maxicab (the connection between the Routing Engine and the backplane, for the M40 router only); SCB, SSB, SFM, or FEB; MCS and PCG (for the M160 router only); each FPC and PIC; and each fan, blower, and impeller.</li> <li>(M120, M320, and T Series routers)—Information about the backplane, power supplies, fan trays, midplane, FPM (craft interface), CIP, PEM, SCG, CB, FPC, PIC, SFP, SPMB, and SIB.</li> <li>(QFX Series)—Information about the chassis, Pseudo CB, Routing Engine, power supplies, fan trays, Interconnect devices, and Node devices. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs).</li> <li>(PTX Series)—Information about the chassis, midplane, craft interface (FPM), power distribution units (PDUs) and Power Supply Modules (PSMs), Centralized Clock Generators (CCGs), Routing Engines, Control Boards (CBs) and Switch Processor Mezzanine Boards (SPMBs), Flexible PIC Concentrators (FPCs), PICs, Switch Interface Boards (SIBs), and fan trays (vertical and horizontal).</li> <li>(MX2010 and MX2020 routers)—Information about the chassis, midplane, craft interface (FPM), power midplane (PMP), Power Supply Modules (PSMs), Power Distribution Modules (PDMs), Routing Engines, Control Boards (CBs) and Switch Processor Mezzanine Boards (SPMBs), Switch Fabric Boards (SFBs), Flexible PIC Concentrators (FPCs), PICs, adapter cards (ADCs) and fan trays.</li> </ul> | All levels      |
| <b>Version</b>       | Revision level of the chassis component.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | All levels      |
| <b>Part number</b>   | Part number of the chassis component.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | All levels      |
| <b>Serial number</b> | Serial number of the chassis component. The serial number of the backplane is also the serial number of the router chassis. Use this serial number when you need to contact Juniper Networks Customer Support about the router or switch chassis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | All levels      |



Table 85: show chassis hardware Output Fields (*continued*)

| Field Name             | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Level of Output  |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Assb ID or Assembly ID | ( <b>extensive</b> keyword only) Identification number that describes the FRU hardware.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>extensive</b> |
| Assembly Version       | ( <b>extensive</b> keyword only) Version number of the FRU hardware.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>extensive</b> |
| Assembly Flags         | ( <b>extensive</b> keyword only) Flags.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>extensive</b> |
| FRU model number       | ( <b>clei-models</b> , <b>extensive</b> , and <b>models</b> keyword only) Model number of the FRU hardware component.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | none specified   |
| CLEI code              | ( <b>clei-models</b> and <b>extensive</b> keyword only) Common Language Equipment Identifier code. This value is displayed only for hardware components that use ID EEPROM format v2. This value is not displayed for components that use ID EEPROM format v1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | none specified   |
| EEPROM Version         | ID EEPROM version used by the hardware component: <b>0x00</b> (version 0), <b>0x01</b> (version 1), or <b>0x02</b> (version 2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>extensive</b> |
| Description            | <p>Brief description of the hardware item:</p> <ul style="list-style-type: none"> <li>Type of power supply.</li> <li>Type of PIC. If the PIC type is not supported on the current software release, the output states <b>Hardware Not Supported</b>.</li> <li>Type of FPC: <b>FPC Type 1</b>, <b>FPC Type 2</b>, <b>FPC Type 3</b>, <b>FPC Type 4</b>, or <b>FPC TypeOC192</b>.</li> </ul> <p>On EX Series switches, a brief description of the FPC.</p> <p>The following list shows the PIM abbreviation in the output and the corresponding PIM name.</p> <ul style="list-style-type: none"> <li><b>2x FE</b>—Either two built-in Fast Ethernet interfaces (fixed PIM) or dual-port Fast Ethernet PIM</li> <li><b>4x FE</b>—4-port Fast Ethernet ePIM</li> <li><b>1x GE Copper</b>—Copper Gigabit Ethernet ePIM (one 10-Mbps, 100-Mbps, or 1000-Mbps port)</li> <li><b>1x GE SFP</b>—SFP Gigabit Ethernet ePIM (one fiber port)</li> <li><b>2x Serial</b>—Dual-port serial PIM</li> <li><b>2x T1</b>—Dual-port T1 PIM</li> <li><b>2x E1</b>—Dual-port E1 PIM</li> <li><b>2x CT1E1</b>—Dual-port channelized T1/E1 PIM</li> <li><b>1x T3</b>—T3 PIM (one port)</li> <li><b>1x E3</b>—E3 PIM (one port)</li> <li><b>4x BRI S/T</b>—4-port ISDN BRI S/T PIM</li> <li><b>4x BRI U</b>—4-port ISDN BRI U PIM</li> <li><b>1x ADSL Annex A</b>—ADSL 2/2+ Annex A PIM (one port, for POTS)</li> <li><b>1x ADSL Annex B</b>—ADSL 2/2+ Annex B PIM (one port, for ISDN)</li> <li><b>2x SHDSL (ATM)</b>—G SHDSL PIM (2-port two-wire module or 1-port four-wire module)</li> </ul> | All levels       |

Table 85: show chassis hardware Output Fields (*continued*)

| Field Name | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
|            | <ul style="list-style-type: none"> <li>• <b>1x TGM550</b>—TGM550 Telephony Gateway Module (Avaya VoIP gateway module with one console port, two analog <b>LINE</b> ports, and two analog <b>TRUNK</b> ports)</li> <li>• <b>1x DS1 TIM510</b>—TIM510 E1/T1 Telephony Interface Module (Avaya VoIP media module with one E1 or T1 trunk termination port and ISDN PRI backup)</li> <li>• <b>4x FXS, 4x FXO, TIM514</b>—TIM514 Analog Telephony Interface Module (Avaya VoIP media module with four analog <b>LINE</b> ports and four analog <b>TRUNK</b> ports)</li> <li>• <b>4x BRI TIM521</b>—TIM521 BRI Telephony Interface Module (Avaya VoIP media module with four ISDN BRI ports)</li> <li>• <b>Crypto Accelerator Module</b>—For enhanced performance of cryptographic algorithms used in IP Security (IPsec) services</li> <li>• <b>MPC M16x10GE</b>—16-port 10-Gigabit Module Port Concentrator that supports SFP+ optical transceivers. (Not on EX Series switches.)</li> <li>• For hosts, the Routing Engine type.</li> <li>• For small form-factor pluggable transceiver (SFP) modules, the type of fiber: <b>LX</b>, <b>SX</b>, <b>LH</b>, or <b>T</b>.</li> <li>• LCD description for EX Series switches (except EX2200 switches).</li> <li>• <b>MPC2</b>—1-port MPC2 that supports two separate slots for MICs.</li> <li>• <b>MPC3E</b>—1-port MPC3E that supports two separate slots for MICs (MIC-3D-1X100GE-CFP and MIC-3D-20GE-SFP) on MX960, MX480, and MX240 routers. The MPC3E maps one MIC to one PIC (1 MIC, 1 PIC), which differs from the mapping of legacy MPCs.</li> <li>• 100GBASE-LR4, pluggable CFP optics</li> <li>• Supports the Enhanced MX Switch Control Board with fabric redundancy and existing SCBs without fabric redundancy.</li> <li>• Interoperates with existing MX Series line cards, including Flexible Port Concentrators (FPC), Dense Port Concentrators (DPCs), and Modular Port Concentrators (MPCs).</li> <li>• <b>MPC4E</b>—Fixed configuration MPC4E that is available in two flavors: MPC4E-3D-32XGE-SFP and MPC4E-3D-2CGE-8XGE on MX2020, MX960, MX480, and MX240 routers.</li> <li>• LCD description for MX Series routers</li> </ul> |                 |

## Sample Output

### show chassis hardware (EX8216 Switch)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis       REV 06   710-016845   CY0109220035   EX8216
Midplane      REV 06   710-016845   BA0909120112   EX8216-MP
CB 0          REV 22   710-020771   AX0109197723   EX8216-RE320
CB 1          REV 22   710-020771   AX0109197726   EX8216-RE320
  Routing Engine 1      BUILTIN      BUILTIN        RE-EX8216
FPC 3         REV 19   710-020683   BC0109083125   EX8200-48F
  CPU         REV 13   710-020598   BF0109144549   EX8200-CPU
FPC 4         REV 17   710-020683   BC0108500127   EX8200-48F
  CPU         REV 10   710-020598   BF0108460510   EX8200-CPU

```

| PIC 0           |        | BUILTIN    | BUILTIN      | 48x 100 Base-QFX/1000 |
|-----------------|--------|------------|--------------|-----------------------|
| Base-X          |        |            |              |                       |
| Xcvr 1          | REV 01 | 740-011613 | PE70V89      | SFP-SX                |
| Xcvr 11         | REV 01 | 740-011613 | PE70YCE      | SFP-SX                |
| Xcvr 12         | REV 01 | 740-011613 | PE70VSH      | SFP-SX                |
| Xcvr 13         | REV 01 | 740-011613 | E08C02063    | SFP-SX                |
| Xcvr 14         | REV 01 | 740-011613 | PE70VKU      | SFP-SX                |
| Xcvr 15         | REV 01 | 740-011613 | E08E03372    | SFP-SX                |
| Xcvr 21         | REV 01 | 740-011613 | PE70VAD      | SFP-SX                |
| Xcvr 22         | REV 01 | 740-011613 | E08E01228    | SFP-SX                |
| Xcvr 23         | REV 01 | 740-011613 | PE70VSL      | SFP-SX                |
| Xcvr 24         | REV 01 | 740-011613 | E08E03409    | SFP-SX                |
| Xcvr 25         | REV 01 | 740-011613 | PE70VL4      | SFP-SX                |
| Xcvr 26         | REV 01 | 740-011613 | PDQ4L2Z      | SFP-SX                |
| Xcvr 27         | REV 01 | 740-011613 | PE70WFK      | SFP-SX                |
| Xcvr 28         | REV 01 | 740-011782 | PBD2B5U      | SFP-SX                |
| Xcvr 29         | REV 01 | 740-011613 | PE70UQX      | SFP-SX                |
| Xcvr 30         | REV 01 | 740-011613 | PE70VL5      | SFP-SX                |
| Xcvr 31         | REV 01 | 740-011613 | PE70V0F      | SFP-SX                |
| Xcvr 32         | REV 01 | 740-011613 | E08C02052    | SFP-SX                |
| Xcvr 33         | REV 01 | 740-011613 | E08C02197    | SFP-SX                |
| Xcvr 34         | REV 01 | 740-011613 | PE70V0L      | SFP-SX                |
| Xcvr 35         | REV 01 | 740-011613 | E08E03390    | SFP-SX                |
| Xcvr 36         | REV 01 | 740-011613 | PDQ4VL9      | SFP-SX                |
| Xcvr 37         | REV 01 | 740-011613 | E08E03370    | SFP-SX                |
| Xcvr 38         | REV 01 | 740-011613 | E08E03362    | SFP-SX                |
| Xcvr 39         | REV 01 | 740-011613 | E08C02065    | SFP-SX                |
| Xcvr 40         | REV 01 | 740-011613 | E08E03405    | SFP-SX                |
| Xcvr 41         | REV 01 | 740-011613 | E08E03411    | SFP-SX                |
| Xcvr 43         | REV 01 | 740-011613 | E08C02171    | SFP-SX                |
| Xcvr 45         | REV 01 | 740-011613 | E08E03410    | SFP-SX                |
| FPC 13          | REV 16 | 710-016837 | BB0109051344 | EX8200-8XS            |
| CPU             |        |            |              |                       |
| SIB 0           | REV 10 | 710-021613 | AY0109166244 | EX8216-SF320          |
| SIB 1           | REV 10 | 710-021613 | AY0109166357 | EX8216-SF320          |
| SIB 2           | REV 10 | 710-021613 | AY0109166362 | EX8216-SF320          |
| SIB 3           | REV 10 | 710-021613 | AY0109166338 | EX8216-SF320          |
| SIB 4           | REV 10 | 710-021613 | AY0109166350 | EX8216-SF320          |
| SIB 5           | REV 10 | 710-021613 | AY0109166365 | EX8216-SF320          |
| SIB 6           | REV 10 | 710-021613 | AY0109166361 | EX8216-SF320          |
| SIB 7           | REV 10 | 710-021613 | AY0109166399 | EX8216-SF320          |
| PSU 0           | REV 17 | 740-021466 | BG0709170003 | EX8200-AC2K           |
| PSU 1           | REV 17 | 740-021466 | BG0709170004 | EX8200-AC2K           |
| PSU 2           | REV 17 | 740-021466 | BG0709170020 | EX8200-AC2K           |
| PSU 3           | REV 17 | 740-021466 | BG0709170017 | EX8200-AC2K           |
| PSU 4           | REV 17 | 740-021466 | BG0709170008 | EX8200-AC2K           |
| PSU 5           | REV 17 | 740-021466 | BG0709170018 | EX8200-AC2K           |
| Top Fan Tray    |        |            |              |                       |
| FTC 0           | REV 4  | 760-022620 | CX1209140212 | EX8216-FT             |
| FTC 1           | REV 4  | 760-022620 | CX1209140212 | EX8216-FT             |
| Bottom Fan Tray |        |            |              |                       |
| FTC 0           | REV 4  | 760-022620 | CX1209140211 | EX8216-FT             |
| FTC 1           | REV 4  | 760-022620 | CX1209140211 | EX8216-FT             |
| LCD 0           | REV 04 | 710-025742 | CE0109186919 | EX8200 LCD            |

### show chassis hardware clei-models (EX8216 Switch)

```

user@host> show chassis hardware clei-models
Hardware inventory:
Item          Version  Part number  CLEI code  FRU model number
Midplane      REV 08   710-016845

```

|                 |        |            |            |                  |
|-----------------|--------|------------|------------|------------------|
| PSU 0           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| PSU 1           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| PSU 2           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| PSU 3           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| PSU 4           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| PSU 5           | REV 05 | 740-023002 | COUPAEAEAA | EX8200-PWR-AC3KR |
| Top Fan Tray    |        |            |            |                  |
| Bottom Fan Tray |        |            |            |                  |

### show chassis hardware clei-models (T1600 Router)

```

user@host> show chassis hardware clei-models
Hardware inventory:

```

| Item             | Version | Part number | CLEI code  | FRU model number      |
|------------------|---------|-------------|------------|-----------------------|
| Midplane         | REV 03  | 710-005608  |            | CHAS-BP-T640-S        |
| FPM Display      | REV 05  | 710-002897  |            | CRAFT-T640-S          |
| CIP              | REV 06  | 710-002895  |            | CIP-L-T640-S          |
| PEM 0            | Rev 07  | 740-017906  | IPUPAC7KTA | PWR-T1600-3-80-DC-S   |
| PEM 1            | Rev 18  | 740-002595  |            | PWR-T-DC-S            |
| SCG 0            | REV 15  | 710-003423  |            | SCG-T-S               |
| Routing Engine 0 | REV 08  | 740-014082  |            | RE-A-2000-4096-S      |
| Routing Engine 1 | REV 07  | 740-014082  |            | RE-A-2000-4096-S      |
| CB 0             | REV 05  | 710-007655  |            | CB-T-S                |
| CB 1             | REV 03  | 710-017707  |            | CB-T-S                |
| FPC 0            | REV 07  | 710-013558  |            | T640-FPC2-E2          |
| PIC 0            | REV 01  | 750-010618  |            | PB-4GE-SFP            |
| PIC 1            | REV 06  | 750-001900  |            | PB-10C48-SON-SMSR     |
| PIC 2            | REV 14  | 750-001901  |            | PB-40C12-SON-SMIR     |
| PIC 3            | REV 07  | 750-001900  |            | PB-10C48-SON-SMSR     |
| FPC 1            | REV 06  | 710-013553  |            | T640-FPC1-E2          |
| PIC 0            | REV 08  | 750-001072  |            | P-1GE-SX              |
| PIC 1            | REV 10  | 750-012266  |            | PB-4GE-TYPE1-SFP-IQ2  |
| PIC 2            | REV 22  | 750-005634  |            | PB-1CHOC12SMIR-QPP    |
| FPC 2            |         |             |            |                       |
| PIC 0            | REV 16  | 750-007141  |            | PC-10GE-SFP           |
| PIC 1            | REV 06  | 750-015217  |            | PC-8GE-TYPE3-SFP-IQ2  |
| PIC 2            | REV 05  | 750-004695  |            | PC-TUNNEL             |
| PIC 3            | REV 17  | 750-009553  |            | PC-40C48-SON-SFP      |
| FPC 3            | REV 01  | 710-010154  |            | T640-FPC3-E           |
| PIC 0            | REV 07  | 750-012793  |            | PC-1XGE-TYPE3-XFP-IQ2 |
| PIC 1            | REV 25  | 750-007141  |            | PC-10GE-SFP           |
| PIC 2            | REV 17  | 750-009553  |            | PC-40C48-SON-SFP      |
| PIC 3            | REV 32  | 750-003700  |            | PC-10C192-SON-VSR     |
| FPC 4            | REV 16  | 710-013037  |            | T1600-FPC4-ES         |
| PIC 1            | REV 06  | 750-034781  |            | PD-1CE-CFP            |
| FPC 5            | REV 02  | 710-013037  |            | T1600-FPC4-ES         |
| PIC 0            | REV 16  | 750-012518  |            | PD-40C192-SON-XFP     |
| PIC 1            | REV 01  | 750-010850  |            | PD-10C768-SON-SR      |
| FPC 6            | REV 14  | 710-013037  |            | T1600-FPC4-ES         |
| PIC 0            | REV 11  | 750-017405  |            | PD-4XGE-XFP           |
| PIC 1            | REV 13  | 750-017405  |            | PD-4XGE-XFP           |
| FPC 7            | REV 09  | 710-007529  |            | T640-FPC3             |
| PIC 0            | REV 10  | 750-012793  |            | PC-1XGE-TYPE3-XFP-IQ2 |
| PIC 1            | REV 01  | 750-015217  |            | PC-8GE-TYPE3-SFP-IQ2  |
| PIC 2            | REV 01  | 750-015217  |            | PC-8GE-TYPE3-SFP-IQ2  |
| PIC 3            | REV 15  | 750-009450  |            | PC-10C192-SON-SR2     |
| SIB 0            | REV 07  | 710-013074  |            | SIB-I-T1600-S         |
| SIB 1            | REV 07  | 710-013074  |            | SIB-I-T1600-S         |
| SIB 2            | REV 07  | 710-013074  |            | SIB-I-T1600-S         |
| SIB 3            | REV 07  | 710-013074  |            | SIB-I-T1600-S         |
| SIB 4            | REV 07  | 710-013074  |            | SIB-I-T1600-S         |

|            |                    |
|------------|--------------------|
| Fan Tray 0 | FANTRAY-T-S        |
| Fan Tray 1 | FANTRAY-T-S        |
| Fan Tray 2 | FAN-REAR-TX-T640-S |

### show chassis hardware (EX2300-C Switch)

```
user@switch> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Pseudo CB 0
Routing Engine 0
FPC 0         REV 04    650-059984   HV0215410003   EX2300-C-12P
  CPU
  PIC 0       REV 04    BUILTIN      BUILTIN        12x10/100/1000 Base-T
  PIC 1       REV 04    650-059984   HV0215410003   2x10G SFP/SFP+
    Xcvr 0    REV 01    740-021309   T09K00695      SFP+-10G-LR
    Xcvr 1    REV 01    740-030658   AD1146A05JT    SFP+-10G-USR
Power Supply 0
JPSU-170W-AC
```

### show chassis hardware (EX2300 Switch)

```
user@switch> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Pseudo CB 0
Routing Engine 0
FPC 0         REV 05    650-059968   JY0215410033   EX2300-24P
  CPU
  PIC 0       REV 05    BUILTIN      BUILTIN        24x10/100/1000 Base-T
  PIC 1       REV 05    650-059968   JY0215410033   4x10G SFP/SFP+
    Xcvr 0    REV 01    740-030658   AD1125A03ES    SFP+-10G-USR
    Xcvr 1    REV 01    740-021308   AJPOTDZ        SFP+-10G-SR
    Xcvr 3    REV 01    740-021309   A9401FL        SFP+-10G-LR
Power Supply 0
JPSU-450W-AC-AFO
Fan Tray 0
(AFO)
Fan Tray 1
(AFO)
Fan Module, Airflow Out
Fan Module, Airflow Out
```

### show chassis hardware detail (EX4200 Switch)

```
user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Routing Engine 0 REV 11    750-021256   BM0208327733   EX4200-24T, 8 POE
Routing Engine 0
FPC 0         REV 11    750-021256   BM0208327733   EX4200-24T, 8 POE
  CPU
  PIC 0       BUILTIN    BUILTIN        FPC CPU
  PIC 1       BUILTIN    BUILTIN        24x 10/100/1000 Base-T
  PIC 1       REV 03B   711-021270   AR0208162285   4x GE SFP
  BRD         REV 08    711-021264   AK0208328289   EX4200-24T, 8 POE
Power Supply 0 REV 03    740-020957   AT0508346354   PS 320W AC
Fan Tray
```

### show chassis hardware (EX4300 Switch)

```
user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
```

|                  |        |            |              |                         |
|------------------|--------|------------|--------------|-------------------------|
| Chassis          |        |            | PD3713160055 | EX4300-48P              |
| Routing Engine 0 | REV 04 | 650-044930 | PD3713160055 | EX4300-48P              |
| FPC 0            | REV 04 | 650-044930 | PD3713160055 | EX4300-48P              |
| CPU              |        | BUILTIN    | BUILTIN      | FPC CPU                 |
| PIC 0            | REV 04 | BUILTIN    | BUILTIN      | 48x 10/100/1000 Base-T  |
| PIC 1            | REV 04 | BUILTIN    | BUILTIN      | 4x 40GE                 |
| Power Supply 0   | REV 01 | 740-046871 | 1EDA3090026  | JPSU-1100-AC-AF0-A      |
| Fan Tray 0 (AF0) |        |            |              | Fan Module, Airflow Out |
| Fan Tray 1 (AF0) |        |            |              | Fan Module, Airflow Out |

### show chassis hardware models (EX4500 Switch)

user@host> show chassis hardware models

Hardware inventory:

| Item             | Version | Part number | Serial number | FRU model number  |
|------------------|---------|-------------|---------------|-------------------|
| Routing Engine 0 | REV 01  | 750-035700  | GG0210271867  | EX4500-40F-FB-C   |
| FPC 0            | REV 01  | 750-035700  | GG0210271867  | EX4500-40F-FB-C   |
| PIC 0            |         | BUILTIN     | BUILTIN       | EX4500-40F-FB-C   |
| Power Supply 1   | REV 01  | 740-029654  | H884FS00JC09  | EX4500-PWR1-AC-FB |

### show chassis hardware detail (EX9200 Switch)

user@switch> show chassis hardware

Hardware inventory:

| Item             | Version | Part number | Serial number | Description            |
|------------------|---------|-------------|---------------|------------------------|
| Chassis          |         |             | JN111DA44RFB  | EX9208                 |
| Midplane         | REV 05  | 710-017414  | TS2912        | EX9208-BP              |
| FPM Board        | REV 02  | 710-017254  | XN1804        | Front Panel Display    |
| PEM 0            | Rev 01  | 740-022697  | QCS0906C033   | PS 1.2-1.7kW; 100-240V |
| AC in            |         |             |               |                        |
| PEM 1            | Rev 01  | 740-022697  | QCS0906C095   | PS 1.2-1.7kW; 100-240V |
| AC in            |         |             |               |                        |
| Routing Engine 0 | REV 08  | 740-031116  | 9009122883    | RE-S-EX9200-1800X4     |
| CB 0             | REV 16  | 750-031391  | CAAW4391      | EX9200-SCBEF           |
| PC 0             | REV 07  | 750-049612  | CABJ9312      | EX9200 40x1G Copper    |
| CPU              | REV 04  | 711-038484  | CABH8268      | MPCE PMB 2G            |
| MIC 0            | REV 02  | 750-049607  | CABT9623      | 40x 1GE RJ45           |
| PIC 0            |         | BUILTIN     | BUILTIN       | 10x 1GE RJ45           |
| PIC 1            |         | BUILTIN     | BUILTIN       | 10x 1GE RJ45           |
| PIC 2            |         | BUILTIN     | BUILTIN       | 10x 1GE RJ45           |
| PIC 3            |         | BUILTIN     | BUILTIN       | 10x 1GE RJ45           |
| FPC 1            | REV 10  | 710-013699  | CAAN3529      | EX9200-40x1G-SFP       |
| CPU              | REV 04  | 711-038484  | CAAL7608      | MPCE PMB 2G            |
| MIC 0            | REV 26  | 750-028392  | CAAS5151      | 20x 1GE SFP            |
| PIC 0            |         | BUILTIN     | BUILTIN       | 10x 1GE SFP            |
| PIC 1            |         | BUILTIN     | BUILTIN       | 10x 1GE SFP            |
| MIC 1            | REV 26  | 750-028392  | CAAC8006      | 20x 1GE SFP            |
| PIC 2            |         | BUILTIN     | BUILTIN       | 10x 1GE SFP            |
| Xcvr 8           | REV 01  | 740-011613  | E08L03674     | SFP-SX                 |
| Xcvr 9           | REV 01  | 740-011613  | E08M00243     | SFP-SX                 |
| PIC 3            |         | BUILTIN     | BUILTIN       | 10x 1GE SFP            |
| FPC 3            | REV 10  | 710-013699  | CAAR5261      | EX9200-40x1G-SFP       |
| CPU              | REV 04  | 711-038484  | CAAS2118      | MPCE PMB 2G            |
| MIC 0            | REV 26  | 750-028392  | CAAS5067      | 20x 1GE SFP            |
| PIC 0            |         | BUILTIN     | BUILTIN       | 10x 1GE SFP            |
| Xcvr 2           | REV 01  | 740-031851  | PNA7L8U       | SFP-SX                 |
| Xcvr 3           | REV 02  | 740-011613  | AM0943SEKGZ   | SFP-SX                 |
| Xcvr 4           | REV 02  | 740-011613  | AM0943SEJZ9   | SFP-SX                 |

|          |        |            |             |               |
|----------|--------|------------|-------------|---------------|
| PIC 1    |        | BUILTIN    | BUILTIN     | 10x 1GE SFP   |
| MIC 1    | REV 26 | 750-028392 | CAAS5132    | 20x 1GE SFP   |
| PIC 2    |        | BUILTIN    | BUILTIN     | 10x 1GE SFP   |
| Xcvr 4   | REV 01 | 740-011613 | E08D02625   | SFP-SX        |
| Xcvr 9   | REV 02 | 740-011613 | PJH4RD9     | SFP-SX        |
| PIC 3    |        | BUILTIN    | BUILTIN     | 10x 1GE SFP   |
| Xcvr 0   | REV 01 | 740-011613 | AM0813S8YME | SFP-SX        |
| Fan Tray |        |            |             | Left Fan Tray |

### show chassis hardware (M7i Router)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item           | Version | Part number | Serial number | Description             |
|----------------|---------|-------------|---------------|-------------------------|
| Chassis        |         |             | 31959         | M7i                     |
| Midplane       | REV 02  | 710-008761  | CA0209        | M7i Midplane            |
| Power Supply 0 | Rev 04  | 740-008537  | PD10272       | AC Power Supply         |
| Routing Engine | REV 01  | 740-008846  | 1000396803    | RE-5.0                  |
| CFEB           | REV 02  | 750-009492  | CA0166        | Internet Processor IIv1 |
| FPC 0          |         |             |               | E-FPC                   |
| PIC 0          | REV 04  | 750-003163  | HJ6416        | 1x G/E, 1000 BASE-SX    |
| PIC 1          | REV 04  | 750-003163  | HJ6423        | 1x G/E, 1000 BASE-SX    |
| PIC 2          | REV 04  | 750-003163  | HJ6421        | 1x G/E, 1000 BASE-SX    |
| PIC 3          | REV 02  | 750-003163  | HJ0425        | 1x G/E, 1000 BASE-SX    |
| FPC 1          |         |             |               | E-FPC                   |
| PIC 2          | REV 01  | 750-009487  | HM2275        | ASP - Integrated        |
| PIC 3          | REV 01  | 750-009098  | CA0142        | 2x F/E, 100 BASE-TX     |

Hardware inventory:

| Item           | Version | Part number | Serial number | Description           |
|----------------|---------|-------------|---------------|-----------------------|
| Chassis        |         |             | B1157         | M7i                   |
| Midplane       | REV 05  | 710-008761  | DM0840        | M7i Midplane          |
| Power Supply 0 | Rev 08  | 740-008537  | TE53755       | AC Power Supply       |
| Routing Engine | REV 07  | 740-011202  | 1000736567    | RE-850                |
| CFEB           | REV 09  | 750-010463  | DK6952        | Internet Processor II |
| FPC 0          |         |             |               | E-FPC                 |
| PIC 0          | REV 12  | 750-012838  | DL7993        | 4x 1GE(LAN), IQ2      |
| Xcvr 0         | REV 01  | 740-011614  | PD94TDJ       | SFP-LX10              |
| Xcvr 1         | REV 01  | 740-011615  | PAD5EER       | UNSUPPORTED           |
| Xcvr 2         | REV 01  | 740-011614  | PD94THU       | SFP-LX10              |
| Xcvr 3         |         | NON-JNPR    | PDC2E7A       | SFP-LX10              |
| PIC 1          | REV 03  | 750-023116  | JT0203        | 4x CHSTM1 SDH CE SFP  |
| Xcvr 0         | REV 01  | 740-012434  | AGT063832PS   | SFP-SR                |
| Xcvr 1         | REV 01  | 740-012434  | AGT063832LY   | SFP-SR                |
| Xcvr 3         | REV 01  | 740-016064  | C06J19018     | SFP-LR                |
| PIC 2          | REV 15  | 750-014895  | DM5757        | MultiServices 100     |
| PIC 3          | REV 01  | 750-025390  | JW9448        | 12x T1/E1 CE          |
| FPC 1          |         |             |               | E-FPC                 |
| PIC 2          |         | BUILTIN     | BUILTIN       | 1x Tunnel             |
| PIC 3          | REV 09  | 750-009099  | DM0899        | 1x G/E, 1000 BASE     |
| Xcvr 0         | REV 01  | 740-012434  | AGT07150HGJ   | UNSUPPORTED           |
| Fan Tray       |         |             |               | Rear Fan Tray         |

### show chassis hardware (M10 Router)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item           | Version | Part number | Serial number | Description |
|----------------|---------|-------------|---------------|-------------|
| Chassis        |         |             | 1122          | M10         |
| Midplane       | REV 1.1 | 710-001950  | S/N AC6626    |             |
| Power supply A | Rev 01  | 740-002497  | S/N LC36095   | AC          |
| Power supply B | Rev 01  | 740-002497  | S/N LC36100   | AC          |

|            |         |            |                  |                       |
|------------|---------|------------|------------------|-----------------------|
| Display    | REV 1.2 | 710-001995 | S/N AC6656       |                       |
| Host       |         |            | 18000005dfb3fb01 | teknor                |
| FEB        | REV 01  | 710-001948 | S/N AC6632       | Internet Processor II |
| FPC 0      |         |            |                  |                       |
| PIC 0      | REV 08  | 750-001072 | S/N AB2485       | 1x G/E, 1000 BASE-SX  |
| PIC 1      | REV 01  | 750-000613 | S/N AA1048       | 1x OC-12 SONET, SMIR  |
| FPC 1      |         |            |                  |                       |
| Fan Tray 0 |         |            |                  | FANTRAY-M10I-S        |
| Fan Tray 1 |         |            |                  | FANTRAY-M10I-S        |

#### show chassis hardware models (M10 Router)

```
user@host> show chassis hardware models
```

Hardware inventory:

| Item             | Version | Part number | CLEI code | FRU model number  |
|------------------|---------|-------------|-----------|-------------------|
| Midplane         | REV 04  | 710-008920  |           | CHAS-MP-M10i-S    |
| Power Supply 0   | Rev 06  | 740-008537  |           | PWR-M10i-M7i-AC-S |
| Power Supply 1   | Rev 06  | 740-008537  |           | PWR-M10i-M7i-AC-S |
| HCM 0            | REV 03  | 710-010580  |           | HCM-M10i-S        |
| HCM 1            | REV 03  | 710-010580  |           | HCM-M10i-S        |
| Routing Engine 0 | REV 09  | 740-009459  |           | RE-400-256-S      |
| CFEB 0           | REV 05  | 750-010465  |           | FEB-M10i-M7i-S    |
| FPC 0            |         |             |           |                   |
| PIC 0            | REV 10  | 750-002971  |           | PE-40C3-SON-MM    |
| PIC 1            | REV 11  | 750-002992  |           | PE-4FE-TX         |
| PIC 2            | REV 03  | 750-002977  |           | PE-20C3-ATM-MM    |
| PIC 3            | REV 08  | 750-005724  |           | PE-20C3-ATM2-MM   |
| FPC 1            |         |             |           |                   |
| PIC 2            | REV 12  | 750-008425  |           | PE-AS             |
| PIC 3            | REV 13  | 750-005636  |           | PE-4CHDS3-QPP     |
| Fan Tray 0       |         |             |           | FANTRAY-M10I-S    |
| Fan Tray 1       |         |             |           | FANTRAY-M10I-S    |

#### show chassis hardware (M20 Router)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item           | Version | Part number | Serial number    | Description           |
|----------------|---------|-------------|------------------|-----------------------|
| Chassis        |         |             | 20033            | M20                   |
| Backplane      | REV 07  | 710-001517  | S/N AA7940       |                       |
| Power supply B | Rev 01  | 740-001465  | S/N 000001       | AC                    |
| Display        | REV 02  | 710-001519  | S/N AA9704       |                       |
| Host 0         |         |             | 98000004f8f27501 | teknor                |
| SSB slot 0     | REV 01  | 710-001951  | S/N AD5905       | Internet Processor II |
| SSRAM bank 0   | REV 01  | 710-001385  | S00480           | 2 MB                  |
| SSRAM bank 1   | REV 01  | 710-001385  | S00490           | 2 MB                  |
| SSRAM bank 2   | REV 01  | 710-001385  | S001:?           | 2 MB                  |
| SSRAM bank 3   | REV 01  | 710-001385  | S00483           | 2 MB                  |
| SSB slot 1     | N/A     | N/A         | N/A              | Backup                |
| FPC 1          | REV 01  | 710-001292  | S/N AB7528       |                       |
| SSRAM          | REV 01  | 710-000077  | S/N 304209       | 1 MB                  |
| SDRAM bank 0   | REV 01  | 710-000099  | S/N 000603       | 64 MB                 |
| SDRAM bank 1   | REV 01  | 710-000099  | S/N 000414       | 64 MB                 |
| PIC 0          | REV 03  | 750-000612  | S/N AB8433       | 2x OC-3 ATM, MM       |
| PIC 1          | REV 01  | 750-000616  | S/N AA1168       | 1x OC-12 ATM, MM      |
| PIC 2          | REV 01  | 750-000613  | S/N AA1008       | 1x OC-12 SONET, SMIR  |
| PIC 3          | REV 01  | 750-002501  | S/N AD5810       | 4x E3                 |
| FPC 2          | REV 01  | 710-001292  | S/N AC0119       |                       |
| SSRAM          | REV 01  | 710-000077  | S/N 503241       | 1 MB                  |
| SDRAM bank 0   | REV 01  | 710-000099  | S/N 306835       | 64 MB                 |
| SDRAM bank 1   | REV 01  | 710-000099  | S/N 306832       | 64 MB                 |



Fan Tray 0  
Fan Tray 1  
Fan Tray 2  
Fan Tray 3

Front Upper Fan Tray  
Front Middle Fan Tray  
Front Bottom Fan Tray  
Rear Fan Tray

### show chassis hardware models (M20 Router)

user@host> show chassis hardware models

Hardware inventory:

| Item             | Version | Part number | CLEI code | FRU model number |
|------------------|---------|-------------|-----------|------------------|
| Backplane        | REV 03  | 710-002334  |           | CHAS-MP-M20-S    |
| Power Supply A   | REV 06  | 740-001465  |           | PWR-M20-AC-S     |
| Display          | REV 04  | 710-001519  |           | CRAFT-M20-S      |
| Routing Engine 0 | REV 06  | 740-003239  |           | RE-333-768-S     |
| Routing Engine 1 | REV 06  | 740-003239  |           | RE-333-768-S     |
| SSB 0            | REV 02  | 710-001951  |           | SSB-E-M20        |
| SSB 1            | N/A     | N/A         |           |                  |
| FPC 0            | REV 03  | 710-003308  |           | FPC-E            |
| PIC 0            | REV 08  | 750-002303  |           | P-4FE-TX         |
| PIC 1            | REV 07  | 750-004745  |           | P-2MCDS3         |
| PIC 2            | REV 03  | 750-002965  |           | PE-4CHDS3        |
| FPC 1            | REV 03  | 710-003308  |           | FPC-E            |
| PIC 0            | REV 03  | 750-002914  |           | P-20C3-ATM-MM    |
| Fan Tray 0       |         |             |           | FANTRAY-F-M20-S  |
| Fan Tray 1       |         |             |           | FANTRAY-F-M20-S  |
| Fan Tray 2       |         |             |           | FANTRAY-F-M20-S  |
| Fan Tray 3       |         |             |           | FANTRAY-R-M20-S  |

### show chassis hardware (M40 Router)

user@host> show chassis hardware

Hardware inventory:

| Item           | Version | Part number | Serial number | Description          |
|----------------|---------|-------------|---------------|----------------------|
| Backplane      | REV 02  | 710-000073  | S/N AA0053    |                      |
| Power supply A | Rev 2   | 740-000235  | S/N 000042    | DC                   |
| Maxicab        | REV X1  | 710-000229  | S/N AA0139    |                      |
| Minicab        | REV X1  | 710-000482  | S/N AA0201    |                      |
| Display        | REV 06  | 710-000150  | S/N AA0905    |                      |
| Host           |         |             |               | cpv5000              |
| SCB            | REV X1  | 710-000075  | S/N AA0158    | Internet Processor I |
| SSRAM bank 0   | REV 02  | 710-000077  | S/N AA2267    | 1 MB                 |
| SSRAM bank 1   | REV 02  | 710-000077  | S/N AA2270    | 1 MB                 |
| SSRAM bank 2   | REV 02  | 710-000077  | S/N AA2269    | 1 MB                 |
| SSRAM bank 3   | REV 02  | 710-000077  | S/N AA2268    | 1 MB                 |
| FPC 0          | REV 01  | 710-000175  | S/N AA0048    |                      |
| SSRAM          | REV 01  | 710-000077  | S/N AA2333    | 1 MB                 |
| SDRAM bank 0   | REV 01  | 710-000099  | S/N AA2332    | 64 MB                |
| SDRAM bank 1   | REV X1  | 710-000099  | S/N AA2337    | 64 MB                |
| PIC 0          | REV 04  | 750-000613  | S/N aa0343    | 1x OC-12 SONET, SMIR |
| PIC 1          | REV 04  | 750-000613  | S/N AA0379    | 1x OC-12 SONET, SMIR |
| PIC 2          | REV 04  | 750-000613  | S/N AA0377    | 1x OC-12 SONET, SMIR |
| PIC 3          | REV 04  | 750-000613  | S/N AA0378    | 1x Tunnel            |
| FPC 2          | REV 01  | 710-000175  | S/N AA0042    |                      |
| SSRAM          | REV 02  | 710-000077  | S/N AA2288    | 1 MB                 |
| SDRAM bank 0   | REV 01  | 710-000099  | S/N AA2331    | 64 MB                |
| SDRAM bank 1   | REV 01  | 710-000099  | S/N AA2330    | 64 MB                |
| PIC 0          | REV X1  | 750-000603  | S/N AA0143    | 4x OC-3 SONET, SMIR  |
| PIC 1          | REV X1  | 750-000615  | S/N AA0149    | 4x OC-3 SONET, MM    |
| PIC 2          | REV X1  | 750-000611  | S/N AA0148    | 4x OC-3 SONET, MM    |
| PIC 3          | REV 04  | 750-000613  | S/N AA0330    | 1x OC-12 SONET, SMIR |
| FPC 4          | REV 01  | 710-000175  | S/N AA0050    |                      |

|              |        |            |            |                      |
|--------------|--------|------------|------------|----------------------|
| SSRAM        | REV 01 | 710-000077 | S/N AA2327 | 1 MB                 |
| SDRAM bank 0 | REV 01 | 710-000099 | S/N AA2329 | 64 MB                |
| SDRAM bank 1 | REV 01 | 710-000099 | S/N AA2328 | 64 MB                |
| PIC 0        | REV 04 | 750-000613 | S/N AA0320 | 1x OC-12 SONET, SMIR |
| PIC 2        | REV 05 | 750-000616 | S/N AA1341 | 1x OC-12 ATM, MM     |
| PIC 3        | REV 08 | 750-001072 | S/N AB2462 | 1x G/E, 1000 BASE-SX |
| FPC 5        | REV 10 | 710-000175 | S/N AA7663 |                      |
| SSRAM        | REV 01 | 710-000077 | S/N 501590 | 1 MB                 |
| SDRAM bank 0 | REV 01 | 710-000099 | S/N 300949 | 64 MB                |
| SDRAM bank 1 | REV 01 | 710-000099 | S/N 300868 | 64 MB                |
| PIC 1        | REV 01 | 750-001323 | S/N AB1670 | 1x Tunnel            |

### show chassis hardware (M40e Router)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item        | Version | Part number | Serial number    | Description           |
|-------------|---------|-------------|------------------|-----------------------|
| Chassis     |         |             |                  | m40e                  |
| Midplane    | REV 01  | 710-005071  | AX3671           |                       |
| FPM CMB     | REV 03  | 710-001642  | AR9074           |                       |
| FPM Display | REV 03  | 710-001647  | AR7331           |                       |
| CIP         | REV 04  | 710-002649  | BB4449           |                       |
| PEM 0       | Rev 01  | 740-003787  | MC12364          | Power Entry Module    |
| PEM 1       | Rev 01  | 740-003787  | MC12383          | Power Entry Module    |
| PCG 0       | REV 07  | 710-001568  | AG1332           |                       |
| PCG 1       | REV 07  | 710-001568  | AR3789           |                       |
| Host 0      |         |             | 3e000007c8176601 | Present               |
| MCS 0       | REV 11  | 710-001226  | AN5813           |                       |
| SFM 0 SPP   | REV 07  | 710-001228  | AG4676           |                       |
| SFM 0 SPR   | REV 05  | 710-002189  | AE4735           | Internet Processor II |
| SFM 1 SPP   | REV 07  | 710-001228  | AP1347           |                       |
| SFM 1 SPR   | REV 05  | 710-002189  | BE0063           | Internet Processor II |
| FPC 0       | REV 01  | 710-011725  | BE0669           | M40e-EP-FPC Type 1    |
| CPU         | REV 01  | 710-004600  | BD9504           |                       |
| PIC 0       | REV 03  | 750-003737  | AY3991           | 4x G/E, 1000 BASE-SX  |
| FPC 1       | REV 01  | 710-005197  | BD9842           | M40e-FPC Type 2       |
| CPU         | REV 01  | 710-004600  | BB4869           |                       |
| PIC 0       | REV 07  | 750-001900  | AR8278           | 1x OC-48 SONET, SMSR  |
| FPC 2       | REV 02  | 710-005197  | BD9824           | M40e-FPC Type 2       |
| CPU         | REV 01  | 710-004600  | BD9531           |                       |
| PIC 0       | REV 03  | 750-003737  | AY3986           | 4x G/E, 1000 BASE-SX  |
| FPC 4       | REV 02  | 710-005078  | BE0664           | M40e-FPC Type 1       |
| CPU         | REV 01  | 710-004600  | BD9559           |                       |
| PIC 0       | REV 03  | 750-001894  | AG7963           | 1x G/E, 1000 BASE-SX  |
| PIC 2       | REV 01  | 750-002575  | AF2472           | 4x OC-3 SONET, SMIR   |
| FPC 6       | REV 02  | 710-005078  | BE0652           | M40e-FPC Type 1       |
| CPU         | REV 01  | 710-004600  | BD9607           |                       |
| PIC 0       | REV 02  | 750-002911  | AN2286           | 4x F/E, 100 BASE-TX   |
| PIC 2       | REV 01  | 750-002577  | AP6345           | 4x OC-3 SONET, MM     |

### show chassis hardware (M120 Router)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item        | Version | Part number | Serial number | Description           |
|-------------|---------|-------------|---------------|-----------------------|
| Chassis     |         |             | JN000054AC    | M120                  |
| Midplane    | REV 01  | 710-013667  | RB4170        | M120 Midplane         |
| FPM Board   | REV 02  | 710-011407  | CJ9186        | M120 FPM Board        |
| FPM Display | REV 02  | 710-011405  | CJ9173        | M120 FPM Display      |
| FPM CIP     | REV 02  | 710-011410  | CJ9221        | M120 FPM CIP          |
| PEM 0       | Rev 05  | 740-011936  | RM28320       | AC Power Entry Module |

|                  |                                |            |              |                         |
|------------------|--------------------------------|------------|--------------|-------------------------|
| PEM 1            | Rev 05                         | 740-011936 | RM28321      | AC Power Entry Module   |
| Routing Engine 0 | REV 03                         | 740-014080 | 1000642883   | RE-A-1000               |
| CB 0             | REV 03                         | 710-011403 | CM8346       | M120 Control Board      |
| CB 1             | REV 06                         | 710-011403 | CP6728       | M120 Control Board      |
| FPC 1            | REV 02                         | 710-015908 | CP6925       | M120 CFPC 10GE          |
| PIC 0            |                                | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN) XFP    |
| Xcvr 0           | REV 01                         | 740-014279 | 62E204N00007 | XFP-10G-LR              |
| FPC 3            | REV 03                         | 710-011393 | CJ9234       | M120 FPC Type 2         |
| PIC 0            | REV 16                         | 750-008155 | NB5229       | 2x G/E IQ, 1000 BASE    |
| Xcvr 0           | REV 01                         | 740-011613 | P9F15JB      | SFP-SX                  |
| Xcvr 1           | REV 01                         | 740-007326 | P4Q0R9G      | SFP-SX                  |
| PIC 1            | REV 09                         | 750-007745 | CG4360       | 4x OC-3 SONET, SMIR     |
| PIC 2            | REV 16                         | 750-008155 | ND7787       | 2x G/E IQ, 1000 BASE    |
| Xcvr 0           | REV 01                         | 740-011613 | P9F12AS      | SFP-SX                  |
| Xcvr 1           | REV 01                         | 740-011613 | P9F1ALU      | SFP-SX                  |
| PIC 3            | REV 07                         | 750-011800 | JW1284       | 8x 1GE(LAN), IQ2        |
| Xcvr 0           | REV 01                         | 740-011613 | P9F1AM6      | SFP-SX                  |
| Xcvr 6           | REV 01                         | 740-011613 | P9F16NN      | SFP-SX                  |
| Xcvr 7           | REV 01                         | 740-011782 | P8C29Y7      | SFP-SX                  |
| Board B          | REV 02                         | 710-011395 | CN3754       | M120 FPC Mezz           |
| FPC 4            | REV 02                         | 710-011398 | CP6741       | M120 FPC Type 3         |
| PIC 0            | REV 16                         | 750-007141 | NB2855       | 10x 1GE(LAN), 1000 BASE |
| Xcvr 0           | REV 01                         | 740-011782 | P922A1F      | SFP-SX                  |
| Xcvr 1           | REV 01                         | 740-011782 | P922A16      | SFP-SX                  |
| Xcvr 2           | REV 01                         | 740-011782 | P922A0U      | SFP-SX                  |
| Xcvr 3           | REV 01                         | 740-011782 | P9229UZ      | SFP-SX                  |
| Xcvr 4           | REV 01                         | 740-009029 | P11JXWP      | SFP-LX                  |
| Xcvr 6           | REV 01                         | 740-011613 | P9F1ALW      | SFP-SX                  |
| FPC 5            | REV 01                         | 710-011388 | CJ9088       | M120 FPC Type 1         |
| PIC 0            | *** Hardware Not Supported *** |            |              |                         |
| PIC 1            | REV 05                         | 750-012052 | NB0410       | 1x CHOC3 IQ SONET, SMLR |
| PIC 2            | REV 01                         | 750-013167 | CM3824       | 4x CHDS3 IQ             |
| PIC 3            | REV 01                         | 750-010240 | CB5366       | 1x G/E SFP, 1000 BASE   |
| Board B          | REV 01                         | 710-011390 | CJ9103       | M120 FPC Mezz Board     |
| FEB 3            | REV 04                         | 710-011663 | CP6673       | M120 FEB                |
| FEB 4            | REV 04                         | 710-011663 | CJ9368       | M120 FEB                |
| FEB 5            | REV 04                         | 710-011663 | CJ9386       | M120 FEB                |
| Fan Tray 0       |                                |            |              | Front Top Fan Tray      |
| Fan Tray 1       |                                |            |              | Front Bottom Fan Tray   |
| Fan Tray 2       |                                |            |              | Rear Top Fan Tray       |
| Fan Tray 3       |                                |            |              | Rear Bottom Fan Tray    |

### show chassis hardware detail (M120 Router)

```
user@host> show chassis hardware detail
```

```
Hardware inventory:
```

| Item             | Version  | Part number        | Serial number             | Description           |
|------------------|----------|--------------------|---------------------------|-----------------------|
| Chassis          |          |                    | JN000054AC                | M120                  |
| Midplane         | REV 01   | 710-013667         | RB4170                    | M120 Midplane         |
| FPM Board        | REV 02   | 710-011407         | CJ9186                    | M120 FPM Board        |
| FPM Display      | REV 02   | 710-011405         | CJ9173                    | M120 FPM Display      |
| FPM CIP          | REV 02   | 710-011410         | CJ9221                    | M120 FPM CIP          |
| PEM 0            | Rev 05   | 740-011936         | RM28320                   | AC Power Entry Module |
| PEM 1            | Rev 05   | 740-011936         | RM28321                   | AC Power Entry Module |
| Routing Engine 0 | REV 03   | 740-014080         | 1000642883                | RE-A-1000             |
| ad0              | 248 MB   | SILICONSYSTEMS INC | 256M 126CT505S0763SC00110 | Compact Flash         |
| ad2              | 38154 MB | HTE541040G9SA00    | MPBBTOX2HS2E3M            | Hard Disk             |
| CB 0             | REV 03   | 710-011403         | CM8346                    | M120 Control Board    |
| CB 1             | REV 06   | 710-011403         | CP6728                    | M120 Control Board    |

|            |                                |            |              |                         |
|------------|--------------------------------|------------|--------------|-------------------------|
| FPC 1      | REV 02                         | 710-015908 | CP6925       | M120 CFPC 10GE          |
| PIC 0      |                                | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN) XFP    |
| Xcvr 0     | REV 01                         | 740-014279 | 62E204N00007 | XFP-10G-LR              |
| FPC 3      | REV 03                         | 710-011393 | CJ9234       | M120 FPC Type 2         |
| PIC 0      | REV 16                         | 750-008155 | NB5229       | 2x G/E IQ, 1000 BASE    |
| Xcvr 0     | REV 01                         | 740-011613 | P9F15JB      | SFP-SX                  |
| Xcvr 1     | REV 01                         | 740-007326 | P4Q0R9G      | SFP-SX                  |
| PIC 1      | REV 09                         | 750-007745 | CG4360       | 4x OC-3 SONET, SMIR     |
| PIC 2      | REV 16                         | 750-008155 | ND7787       | 2x G/E IQ, 1000 BASE    |
| Xcvr 0     | REV 01                         | 740-011613 | P9F12AS      | SFP-SX                  |
| Xcvr 1     | REV 01                         | 740-011613 | P9F1ALU      | SFP-SX                  |
| PIC 3      | REV 07                         | 750-011800 | JW1284       | 8x 1GE(LAN), IQ2        |
| Xcvr 0     | REV 01                         | 740-011613 | P9F1AM6      | SFP-SX                  |
| Xcvr 6     | REV 01                         | 740-011613 | P9F16NN      | SFP-SX                  |
| Xcvr 7     | REV 01                         | 740-011782 | P8C29Y7      | SFP-SX                  |
| Board B    | REV 02                         | 710-011395 | CN3754       | M120 FPC Mezz           |
| FPC 4      | REV 02                         | 710-011398 | CP6741       | M120 FPC Type 3         |
| PIC 0      | REV 16                         | 750-007141 | NB2855       | 10x 1GE(LAN), 1000 BASE |
| Xcvr 0     | REV 01                         | 740-011782 | P922A1F      | SFP-SX                  |
| Xcvr 1     | REV 01                         | 740-011782 | P922A16      | SFP-SX                  |
| Xcvr 2     | REV 01                         | 740-011782 | P922A0U      | SFP-SX                  |
| Xcvr 3     | REV 01                         | 740-011782 | P9229UZ      | SFP-SX                  |
| Xcvr 4     | REV 01                         | 740-009029 | P11JXWP      | SFP-LX                  |
| Xcvr 6     | REV 01                         | 740-011613 | P9F1ALW      | SFP-SX                  |
| FPC 5      | REV 01                         | 710-011388 | CJ9088       | M120 FPC Type 1         |
| PIC 0      | *** Hardware Not Supported *** |            |              |                         |
| PIC 1      | REV 05                         | 750-012052 | NB0410       | 1x CHOC3 IQ SONET, SMLR |
| PIC 2      | REV 01                         | 750-013167 | CM3824       | 4x CHDS3 IQ             |
| PIC 3      | REV 01                         | 750-010240 | CB5366       | 1x G/E SFP, 1000 BASE   |
| Board B    | REV 01                         | 710-011390 | CJ9103       | M120 FPC Mezz Board     |
| FEB 3      | REV 04                         | 710-011663 | CP6673       | M120 FEB                |
| FEB 4      | REV 04                         | 710-011663 | CJ9368       | M120 FEB                |
| FEB 5      | REV 04                         | 710-011663 | CJ9386       | M120 FEB                |
| Fan Tray 0 |                                |            |              | Front Top Fan Tray      |
| Fan Tray 1 |                                |            |              | Front Bottom Fan Tray   |
| Fan Tray 2 |                                |            |              | Rear Top Fan Tray       |
| Fan Tray 3 |                                |            |              | Rear Bottom Fan Tray    |

#### show chassis hardware models (M120 Router)

```
user@host> show chassis hardware models
```

| Hardware inventory: |         |             |           |                      |
|---------------------|---------|-------------|-----------|----------------------|
| Item                | Version | Part number | CLEI code | FRU model number     |
| Midplane            | REV 01  | 710-013667  |           |                      |
| FPM CIP             | REV 02  | 710-011410  |           | CRAFT-M120-S         |
| PEM 0               | Rev 05  | 740-011936  |           | PWR-M120-AC-S        |
| PEM 1               | Rev 05  | 740-011936  |           | PWR-M120-AC-S        |
| Routing Engine 0    | REV 03  | 740-014080  |           | RE-A-1000-2048-S     |
| CB 0                | REV 03  | 710-011403  |           | CB-M120-S            |
| CB 1                | REV 06  | 710-011403  |           | CB-M120-S            |
| FPC 1               | REV 02  | 710-015908  |           | M120-cFPC-1XGE-XFP   |
| FPC 3               |         |             |           |                      |
| PIC 0               | REV 16  | 750-008155  |           | PB-2GE-SFP-QPP       |
| PIC 1               | REV 09  | 750-007745  |           | PC-40C3-SON-SMIR     |
| PIC 2               | REV 16  | 750-008155  |           | PB-2GE-SFP-QPP       |
| PIC 3               | REV 07  | 750-011800  |           | PB-8GE-TYPE2-SFP-IQ2 |
| FPC 4               |         |             |           |                      |
| PIC 0               | REV 16  | 750-007141  |           | PC-10GE-SFP          |
| FPC 5               |         |             |           |                      |

|            |        |            |                    |
|------------|--------|------------|--------------------|
| PIC 1      | REV 05 | 750-012052 | PB-1CHOC3-SMIR-QPP |
| PIC 2      | REV 01 | 750-013167 | PE-4CHDS3-QPP      |
| PIC 3      | REV 01 | 750-010240 | PB-1GE-SFP         |
| Fan Tray 0 |        |            | FFANTRAY-M120-S    |
| Fan Tray 1 |        |            | FFANTRAY-M120-S    |
| Fan Tray 2 |        |            | RFANTRAY-M120-S    |
| Fan Tray 3 |        |            | RFANTRAY-M120-S    |

### show chassis hardware (M160 Router)

```
user@host> show chassis hardware
```

| Item        | Version | Part number | Serial number    | Description          |
|-------------|---------|-------------|------------------|----------------------|
| Chassis     |         |             | 101              | M160                 |
| Midplane    | REV 02  | 710-001245  | S/N AB4107       |                      |
| FPM CMB     | REV 01  | 710-001642  | S/N AA2911       |                      |
| FPM Display | REV 01  | 710-001647  | S/N AA2999       |                      |
| CIP         | REV 02  | 710-001593  | S/N AA9563       |                      |
| PEM 0       | Rev 01  | 740-001243  | S/N KJ35769      | DC                   |
| PEM 1       | Rev 01  | 740-001243  | S/N KJ35765      | DC                   |
| PCG 0       | REV 01  | 710-001568  | S/N AA9794       |                      |
| PCG 1       | REV 01  | 710-001568  | S/N AA9804       |                      |
| Host 1      |         |             | da000004f8d57001 | teknor               |
| MCS 1       | REV 03  | 710-001226  | S/N AA9777       |                      |
| SFM 0 SPP   | REV 04  | 710-001228  | S/N AA2975       |                      |
| SFM 0 SPR   | REV 02  | 710-001224  | S/N AA9838       | Internet Processor I |
| SFM 1 SPP   | REV 04  | 710-001228  | S/N AA2860       |                      |
| SFM 1 SPR   | REV 01  | 710-001224  | S/N AB0139       | Internet Processor I |
| FPC 0       | REV 03  | 710-001255  | S/N AA9806       | FPC Type 1           |
| CPU         | REV 02  | 710-001217  | S/N AA9590       |                      |
| PIC 1       | REV 05  | 750-000616  | S/N AA1527       | 1x OC-12 ATM, MM     |
| PIC 2       | REV 05  | 750-000616  | S/N AA1535       | 1x OC-12 ATM, MM     |
| PIC 3       | REV 01  | 750-000616  | S/N AA1519       | 1x OC-12 ATM, MM     |
| FPC 1       | REV 02  | 710-001611  | S/N AA9523       | FPC Type 2           |
| CPU         | REV 02  | 710-001217  | S/N AA9571       |                      |
| PIC 0       | REV 03  | 750-001900  | S/N AA9626       | 1x STM-16 SDH, SMIR  |
| PIC 1       | REV 01  | 710-002381  | S/N AD3633       | 2x G/E, 1000 BASE-SX |
| FPC 2       |         |             |                  | FPC Type OC192       |
| CPU         | REV 03  | 710-001217  | S/N AB3329       |                      |
| PIC 0       | REV 01  |             |                  | 1x OC-192 SM SR-2    |
| Fan Tray 0  |         |             |                  | Rear Bottom Blower   |
| Fan Tray 1  |         |             |                  | Rear Top Blower      |
| Fan Tray 2  |         |             |                  | Front Top Blower     |
| Fan Tray 3  |         |             |                  | Front Fan Tray       |

### show chassis hardware models (M160 Router)

```
user@host> show chassis hardware models
```

Hardware inventory:

| Item             | Version | Part number | CLEI code | FRU model number  |
|------------------|---------|-------------|-----------|-------------------|
| Midplane         | REV 03  | 710-009120  |           | CHAS-BP-M320-S    |
| FPM Display      | REV 02  | 710-009351  |           | CRAFT-M320-S      |
| CIP              | REV 03  | 710-005926  |           | CIP-M320-S        |
| PEM 2            | Rev X4  | 740-009148  |           | PWR-M-DC-S        |
| PEM 3            | Rev X4  | 740-009148  |           | PWR-M-DC-S        |
| Routing Engine 0 | REV 02  | 740-008883  |           | RE-1600-2048-S    |
| Routing Engine 1 | REV 02  | 740-008883  |           | RE-1600-2048-S    |
| FPC 0            | REV 02  | 710-010419  |           | M320-FPC1         |
| PIC 0            | REV 01  | 750-001323  |           | P-TUNNEL          |
| PIC 1            | REV 02  | 750-002987  |           | PE-10C12-SON-SMIR |
| PIC 2            | REV 04  | 750-001894  |           | PB-1GE-SX         |
| PIC 3            | REV 04  | 750-001896  |           | PB-10C12-SON-SMIR |

|            |        |            |                    |
|------------|--------|------------|--------------------|
| FPC 1      | REV 02 | 710-010419 | M320-FPC1          |
| PIC 0      | REV 04 | 750-001894 | PB-1GE-SX          |
| PIC 1      | REV 04 | 750-001894 | PB-1GE-SX          |
| PIC 3      | REV 03 | 750-001894 | PB-1GE-SX          |
| FPC 2      | REV 02 | 710-010419 | M320-FPC1          |
| PIC 0      | REV 10 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 1      | REV 10 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 2      | REV 07 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 3      | REV 07 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 1      | REV 10 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 2      | REV 07 | 750-005634 | PB-1CHOC12SMIR-QPP |
| PIC 3      | REV 07 | 750-005634 | PB-1CHOC12SMIR-QPP |
| FPC 3      |        |            |                    |
| PIC 0      | REV 03 | 750-001895 | PB-10C12-SON-MM    |
| PIC 1      | REV 04 | 750-001894 | PB-1GE-SX          |
| PIC 3      | REV 04 | 750-003141 | PB-1GE-SX-B        |
| FPC 4      | REV 02 | 710-010419 | M320-FPC1          |
| FPC 5      | REV 02 | 710-010419 | M320-FPC1          |
| FPC 6      | REV 02 | 710-010419 | M320-FPC1          |
| FPC 7      |        |            |                    |
| PIC 0      | REV 15 | 750-001901 | PB-40C12-SON-SMIR  |
| PIC 1      | REV 06 | 750-001900 | PB-10C48-SON-SMSR  |
| PIC 2      | REV 07 | 750-001900 | PB-10C48-SON-SMSR  |
| PIC 3      | REV 05 | 750-003737 | PB-4GE-SX          |
| SIB 0      | REV 03 | 710-009184 | SIB-M-S            |
| SIB 1      | REV 03 | 710-009184 | SIB-M-S            |
| SIB 2      | REV 03 | 710-009184 | SIB-M-S            |
| SIB 3      | REV 03 | 710-009184 | SIB-M-S            |
| Fan Tray 0 |        |            | FFANTRAY-M320-S    |
| Fan Tray 1 |        |            | FFANTRAY-M320-S    |
| Fan Tray 2 |        |            | RFANTRAY-M320-S    |

### show chassis hardware detail (M160 Router)

```
user@host> show chassis hardware detail
```

Hardware inventory:

| Item         | Version | Part number | Serial number    | Description          |
|--------------|---------|-------------|------------------|----------------------|
| Chassis      |         |             | 101              | M160                 |
| Midplane     | REV 02  | 710-001245  | S/N AB4107       |                      |
| FPM CMB      | REV 01  | 710-001642  | S/N AA2911       |                      |
| FPM Display  | REV 01  | 710-001647  | S/N AA2999       |                      |
| CIP          | REV 02  | 710-001593  | S/N AA9563       |                      |
| PEM 0        | Rev 01  | 740-001243  | S/N KJ35769      | DC                   |
| PEM 1        | Rev 01  | 740-001243  | S/N KJ35765      | DC                   |
| PCG 0        | REV 01  | 710-001568  | S/N AA9794       |                      |
| PCG 1        | REV 01  | 710-001568  | S/N AA9804       |                      |
| Host 1       |         |             | da000004f8d57001 | teknor               |
| MCS 1        | REV 03  | 710-001226  | S/N AA9777       |                      |
| SFM 0 SPP    | REV 04  | 710-001228  | S/N AA2975       |                      |
| SFM 0 SPR    | REV 02  | 710-001224  | S/N AA9838       | Internet Processor I |
| SSRAM bank 0 | REV 01  | 710-000077  | S/N 306456       | 1 MB                 |
| SSRAM bank 1 | REV 01  | 710-000077  | S/N 306474       | 1 MB                 |
| SSRAM bank 2 | REV 01  | 710-000077  | S/N 306388       | 1 MB                 |
| SSRAM bank 3 | REV 01  | 710-000077  | S/N 306392       | 1 MB                 |
| SFM 1 SPP    | REV 04  | 710-001228  | S/N AA2860       |                      |
| SFM 1 SPR    | REV 01  | 710-001224  | S/N AB0139       | Internet Processor I |
| SSRAM bank 0 | REV 01  | 710-000077  | S/N 302917       | 1 MB                 |
| SSRAM bank 1 | REV 01  | 710-000077  | S/N 302662       | 1 MB                 |
| SSRAM bank 2 | REV 01  | 710-000077  | S/N 302593       | 1 MB                 |
| SSRAM bank 3 | REV 01  | 710-000077  | S/N 100160       | 1 MB                 |
| FPC 0        | REV 03  | 710-001255  | S/N AA9806       | FPC Type 1           |

|           |        |            |            |                      |
|-----------|--------|------------|------------|----------------------|
| CPU       | REV 02 | 710-001217 | S/N AA9590 |                      |
| SSRAM     | REV 01 | 710-000077 | S/N 302836 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00141     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S0010;     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 302633 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00143     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S00115     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 302952 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00135     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S001=3     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 302892 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00076     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S001=5     | 32 MB                |
| PIC 1     | REV 05 | 750-000616 | S/N AA1527 | 1x OC-12 ATM, MM     |
| PIC 2     | REV 05 | 750-000616 | S/N AA1535 | 1x OC-12 ATM, MM     |
| PIC 3     | REV 01 | 750-000616 | S/N AA1519 | 1x OC-12 ATM, MM     |
| FPC 1     | REV 02 | 710-001611 | S/N AA9523 | FPC Type 2           |
| CPU       | REV 02 | 710-001217 | S/N AA9571 |                      |
| SSRAM     | REV 01 | 710-000077 | S/N 306340 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00012     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S0001?     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 306454 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00028     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S0002?     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 306492 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00015     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S00031     | 32 MB                |
| SSRAM     | REV 01 | 710-000077 | S/N 306363 | 1 MB                 |
| SDRAM 0   | REV 01 | 710-001196 | S00013     | 32 MB                |
| SDRAM 1   | REV 01 | 710-001196 | S00032     | 32 MB                |
| PIC 0     | REV 03 | 750-001900 | S/N AA9626 | 1x STM-16 SDH, SMIR  |
| PIC 1     | REV 01 | 710-002381 | S/N AD3633 | 2x G/E, 1000 BASE-SX |
| FPC 2     |        |            |            | FPC Type OC192       |
| ... SSRAM | REV 01 | 710-000077 | S/N 306466 | 1 MB                 |

### show chassis hardware (M320 Router)

```
user@host> show chassis hardware
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description           |
|------------------|---------|-------------|---------------|-----------------------|
| Chassis          |         |             | 67245         | M320                  |
| Midplane         | REV 05  | 710-009120  | RB1202        | M320 Midplane         |
| FPM GBUS         | REV 04  | 710-005928  | HZ5697        | M320 Board            |
| FPM Display      | REV 05  | 710-009351  | HR1464        | M320 FPM Display      |
| CIP              | REV 04  | 710-005926  | HT8672        | M320 CIP              |
| PEM 0            | Rev 05  | 740-009148  | QK34208       | DC Power Entry Module |
| PEM 1            | Rev 05  | 740-009148  | QK34262       | DC Power Entry Module |
| PEM 2            | Rev 05  | 740-009148  | QF10449       | DC Power Entry Module |
| PEM 3            | Rev 05  | 740-009148  | QJ18257       | DC Power Entry Module |
| Routing Engine 0 | REV 06  | 740-008883  | P11123901185  | RE-4.0                |
| CB 0             | REV 07  | 710-009115  | JB2382        | M320 Control Board    |
| FPC 0            | REV 02  | 710-005017  | CD9926        | M320 FPC Type 2       |
| CPU              | REV 01  | 710-011659  | CJ6940        | M320 PCA SCPU         |
| PIC 0            | REV 07  | 750-001900  | AT1594        | 1x OC-48 SONET, SMSR  |
| PIC 1            | REV 03  | 750-001850  | HS2746        | 1x Tunnel             |
| PIC 2            | REV 05  | 750-010618  | JE7117        | 4x G/E SFP, 1000 BASE |
| PIC 3            | REV 06  | 750-001900  | HE6083        | 1x OC-48 SONET, SMSR  |
| FPC 2            | REV 02  | 710-005017  | CH0319        | M320 FPC Type 1       |
| CPU              | REV 01  | 710-011659  | CJ6942        | M320 PCA SCPU         |
| PIC 0            | REV 05  | 750-003034  | BD8705        | 4x OC-3 SONET, SMIR   |
| FPC 5            | REV 02  | 710-005017  | CD9938        | M320 FPC Type 2       |

|            |        |            |        |                       |
|------------|--------|------------|--------|-----------------------|
| CPU        |        |            |        |                       |
| FPC 7      | REV 02 | 710-005017 | CD9934 | M320 FPC Type 2       |
| CPU        |        |            |        |                       |
| SIB 0      | REV 09 | 710-009184 | JA6540 | M320 SIB              |
| SIB 1      | REV 09 | 710-009184 | HV9511 | M320 SIB              |
| SIB 2      | REV 09 | 710-009184 | HW2057 | M320 SIB              |
| SIB 3      | REV 09 | 710-009184 | JA6687 | M320 SIB              |
| Fan Tray 0 |        |            |        | Front Top Fan Tray    |
| Fan Tray 1 |        |            |        | Front Bottom Fan Tray |
| Fan Tray 2 |        |            |        | Rear Fan Tray         |

### show chassis hardware models (M320 Router)

```

user@host> show chassis hardware models
Hardware inventory:

```

| Item             | Version | Part number | CLEI code | FRU model number   |
|------------------|---------|-------------|-----------|--------------------|
| Midplane         | REV 03  | 710-009120  |           | CHAS-BP-M320-S     |
| FPM Display      | REV 02  | 710-009351  |           | CRAFT-M320-S       |
| CIP              | REV 03  | 710-005926  |           | CIP-M320-S         |
| PEM 2            | Rev X4  | 740-009148  |           | PWR-M-DC-S         |
| PEM 3            | Rev X4  | 740-009148  |           | PWR-M-DC-S         |
| Routing Engine 0 | REV 02  | 740-008883  |           | RE-1600-2048-S     |
| Routing Engine 1 | REV 02  | 740-008883  |           | RE-1600-2048-S     |
| FPC 0            | REV 02  | 710-010419  |           | M320-FPC1          |
| PIC 0            | REV 01  | 750-001323  |           | P-TUNNEL           |
| PIC 1            | REV 02  | 750-002987  |           | PE-10C12-SON-SMIR  |
| PIC 2            | REV 04  | 750-001894  |           | PB-1GE-SX          |
| PIC 3            | REV 04  | 750-001896  |           | PB-10C12-SON-SMIR  |
| FPC 1            | REV 02  | 710-010419  |           | M320-FPC1          |
| PIC 0            | REV 04  | 750-001894  |           | PB-1GE-SX          |
| PIC 1            | REV 04  | 750-001894  |           | PB-1GE-SX          |
| PIC 3            | REV 03  | 750-001894  |           | PB-1GE-SX          |
| FPC 2            | REV 02  | 710-010419  |           | M320-FPC1          |
| PIC 0            | REV 10  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 1            | REV 10  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 2            | REV 07  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 3            | REV 07  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 1            | REV 10  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 2            | REV 07  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| PIC 3            | REV 07  | 750-005634  |           | PB-1CHOC12SMIR-QPP |
| FPC 3            |         |             |           |                    |
| PIC 0            | REV 03  | 750-001895  |           | PB-10C12-SON-MM    |
| PIC 1            | REV 04  | 750-001894  |           | PB-1GE-SX          |
| PIC 3            | REV 04  | 750-003141  |           | PB-1GE-SX-B        |
| FPC 4            | REV 02  | 710-010419  |           | M320-FPC1          |
| FPC 5            | REV 02  | 710-010419  |           | M320-FPC1          |
| FPC 6            | REV 02  | 710-010419  |           | M320-FPC1          |
| FPC 7            |         |             |           |                    |
| PIC 0            | REV 15  | 750-001901  |           | PB-40C12-SON-SMIR  |
| PIC 1            | REV 06  | 750-001900  |           | PB-10C48-SON-SMSR  |
| PIC 2            | REV 07  | 750-001900  |           | PB-10C48-SON-SMSR  |
| PIC 3            | REV 05  | 750-003737  |           | PB-4GE-SX          |
| SIB 0            | REV 03  | 710-009184  |           | SIB-M-S            |
| SIB 1            | REV 03  | 710-009184  |           | SIB-M-S            |
| SIB 2            | REV 03  | 710-009184  |           | SIB-M-S            |
| SIB 3            | REV 03  | 710-009184  |           | SIB-M-S            |
| Fan Tray 0       |         |             |           | FFANTRAY-M320-S    |
| Fan Tray 1       |         |             |           | FFANTRAY-M320-S    |
| Fan Tray 2       |         |             |           | RFANTRAY-M320-S    |



## show chassis hardware (MX5 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number  Description
Chassis                               E1368          MX5-T
Midplane          REV 01   711-038215   YF5288         MX5-T
PEM 0             Rev 04   740-028288   VA01215        AC Power Entry Module
PEM 1             Rev 04   740-028288   VA01218        AC Power Entry Module
Routing Engine    BUILTIN  BUILTIN      BUILTIN        Routing Engine
TFEB 0            BUILTIN  BUILTIN      BUILTIN        Forwarding Engine
Processor
  QXM 0           REV 05   711-028408   ZA9136         MPC QXM
  FPC 0            BUILTIN  BUILTIN      BUILTIN        MPC BUILTIN
  MIC 0            BUILTIN  BUILTIN      BUILTIN        4x 10GE XFP
  PIC 0            BUILTIN  BUILTIN      BUILTIN        4x 10GE XFP
  FPC 1            BUILTIN  BUILTIN      BUILTIN        MPC BUILTIN
  MIC 0           REV 24   750-028392   YX9820         3D 20x 1GE(LAN) SFP
  PIC 0            BUILTIN  BUILTIN      BUILTIN        10x 1GE(LAN) SFP
    Xcvr 0         REV 01   740-031851   AM1045SUAQ3    SFP-SX
    Xcvr 1         REV 01   740-031851   AM1045SUAPA    SFP-SX
    Xcvr 2         REV 01   740-031851   AM1045SUAN7    SFP-SX
    Xcvr 3         REV 01   740-031851   AM1045SU91Q    SFP-SX
    Xcvr 4         REV 01   740-031851   AM1045SUDDR    SFP-SX
    Xcvr 9         REV 01   740-011613   AM0848SB6A1    SFP-SX
  PIC 1            BUILTIN  BUILTIN      BUILTIN        10x 1GE(LAN) SFP
    Xcvr 0         REV 01   740-031851   AM1045SUANO    SFP-SX
    Xcvr 1         REV 01   740-011613   AS0812S0719    SFP-SX
    Xcvr 2         REV 01   740-011613   AM0821SA121    SFP-SX
    Xcvr 3         REV 01   740-011613   PF21K21        SFP-SX
    Xcvr 4         REV 01   740-011613   AM0848SB69Z    SFP-SX
    Xcvr 5         REV 01   740-011782   P9POXV3        SFP-SX
    Xcvr 6         REV 01   740-011613   AM0812S8WJN    SFP-SX
    Xcvr 7         REV 01   740-011613   PAM3G9Q        SFP-SX
    Xcvr 8         REV 01   740-011613   AM0848SB4A6    SFP-SX
    Xcvr 9         REV 01   740-011782   P9MOU37        SFP-SX
  MIC 1           REV 20   750-028380   ZG2657         3D 2x 10GE XFP
  PIC 2            BUILTIN  BUILTIN      BUILTIN        1x 10GE XFP
  PIC 3            BUILTIN  BUILTIN      BUILTIN        1x 10GE XFP
Fan Tray

```

## show chassis hardware (MX10 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number  Description
Chassis                               E1372          MX10-T
Midplane          REV 01   711-038211   YF5285         MX10-T
PEM 0             Rev 04   740-028288   VB01678        AC Power Entry Module
Routing Engine    BUILTIN  BUILTIN      BUILTIN        Routing Engine
TFEB 0            BUILTIN  BUILTIN      BUILTIN        Forwarding Engine
Processor
  QXM 0           REV 05   711-028408   ZA9053         MPC QXM
  FPC 0            BUILTIN  BUILTIN      BUILTIN        MPC BUILTIN
  MIC 0            BUILTIN  BUILTIN      BUILTIN        4x 10GE XFP
  PIC 0            BUILTIN  BUILTIN      BUILTIN        4x 10GE XFP
  FPC 1            BUILTIN  BUILTIN      BUILTIN        MPC BUILTIN
  MIC 0           REV 24   750-028392   YX9436         3D 20x 1GE(LAN) SFP
  PIC 0            BUILTIN  BUILTIN      BUILTIN        10x 1GE(LAN) SFP
    Xcvr 0         REV 01   740-031851   AM1107SUFQW    SFP-SX

```

|          |         |         |                  |
|----------|---------|---------|------------------|
| PIC 1    | BUILTIN | BUILTIN | 10x 1GE(LAN) SFP |
| Fan Tray |         |         | Fan Tray         |

**show chassis hardware (MX40 Router)**

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               E1367          MX40-T
Midplane                               YF5284         MX40-T
PEM 0          Rev 04    740-028288   VB01680        AC Power Entry Module
PEM 1          Rev 04    740-028288   VB01700        AC Power Entry Module
Routing Engine                               BUILTIN        Routing Engine
TFEB 0          BUILTIN   BUILTIN      Forwarding Engine
Processor
  QXM 0          REV 05    711-028408   ZA9048         MPC QXM
  FPC 0          BUILTIN   BUILTIN      MPC BUILTIN
    MIC 0          BUILTIN   BUILTIN      4x 10GE XFP
      PIC 0          BUILTIN   BUILTIN      4x 10GE XFP
        Xcvr 0      REV 01    740-014279   M7067UPP       XFP-10G-LR
        Xcvr 1          NON-JNPR   K9J02UN       XFP-10G-LR
  FPC 1          BUILTIN   BUILTIN      MPC BUILTIN
    MIC 0          REV 24    750-028392   YX3504         3D 20x 1GE(LAN) SFP
      PIC 0          BUILTIN   BUILTIN      10x 1GE(LAN) SFP
        Xcvr 0      REV 01    740-011613   AM0812S8WTE    SFP-SX
        Xcvr 1      REV 01    740-011613   PFA6KV2         SFP-SX
        Xcvr 2      REV 01    740-031851   AM1045SUDDM     SFP-SX
        Xcvr 3      REV 01    740-011613   PD63C7M         SFP-SX
        Xcvr 4      REV 01    740-011613   PD63DJY         SFP-SX
        Xcvr 5      REV 02    740-011613   AA0950STLL9     SFP-SX
        Xcvr 6      REV 01    740-011782   PAR1YHC         SFP-SX
        Xcvr 7      REV 01    740-011782   P9P0XXL         SFP-SX
        Xcvr 8      REV 01    740-011613   PD63D95         SFP-SX
        Xcvr 9      REV 01    740-031851   AM1045SU9B8     SFP-SX
      PIC 1          BUILTIN   BUILTIN      10x 1GE(LAN) SFP
        Xcvr 0      REV 01    740-011613   PF21L3Z         SFP-SX
        Xcvr 1      REV 01    740-031851   AM1045SU7M9     SFP-SX
        Xcvr 2      REV 01    740-031851   AM1045SUAPT     SFP-SX
        Xcvr 3      REV 01    740-011613   PFF2BZH         SFP-SX
        Xcvr 4      REV 01    740-031851   AM1045SUDDN     SFP-SX
        Xcvr 5      REV 01    740-031851   AM1039S00ZR     SFP-SX
        Xcvr 6      REV 01    740-031851   AM1045SUD6Y     SFP-SX
        Xcvr 8      REV 01    740-011613   PFM1QBS         SFP-SX
        Xcvr 9      REV 01    740-011613   PFF2E25         SFP-SX
    MIC 1          REV 01    750-021130   KG4391         3D 2x 10GE XFP
      PIC 2          BUILTIN   BUILTIN      1x 10GE XFP
        Xcvr 0      REV 01    740-011571   C645XJ04G       XFP-10G-SR
      PIC 3          BUILTIN   BUILTIN      1x 10GE XFP
        Xcvr 0          NON-JNPR   CA49BK0AE       XFP-10G-SR
Fan Tray                               Fan Tray

```

**show chassis hardware (Fixed MX80 Router)**

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               MX80-48T
Midplane      REV 01    711-031603   KF9250         MX80-48T
Routing Engine                               BUILTIN        Routing Engine
FEB 0          BUILTIN   BUILTIN      Forwarding Engine Board
FPC 0          BUILTIN   BUILTIN      MPC BUILTIN

```

|          |        |            |              |                   |
|----------|--------|------------|--------------|-------------------|
| MIC 0    |        | BUILTIN    | BUILTIN      | 4x 10GE XFP       |
| PIC 0    |        | BUILTIN    | BUILTIN      | 4x 10GE XFP       |
| Xcvr 0   |        | NON-JNPR   | M6439D41     | XFP-10G-LR        |
| Xcvr 1   | REV 01 | 740-014279 | 6XE931N00202 | XFP-10G-LR        |
| Xcvr 2   | REV 01 | 740-014289 | C715XU05F    | XFP-10G-SR        |
| Xcvr 3   | REV 01 | 740-014289 | C650XU0EP    | XFP-10G-SR        |
| FPC 1    |        | BUILTIN    | BUILTIN      | MPC BUILTIN       |
| MIC 0    | REV 01 | 711-029399 | JR6981       | 12x 1GE(LAN) RJ45 |
| PIC 0    |        | BUILTIN    | BUILTIN      | 12x 1GE(LAN) RJ45 |
| PIC 1    |        | BUILTIN    | BUILTIN      | 12x 1GE(LAN) RJ45 |
| MIC 1    | REV 01 | BUILTIN    | BUILTIN      | 12x 1GE(LAN) RJ45 |
| PIC 2    |        | BUILTIN    | BUILTIN      | 12x 1GE(LAN) RJ45 |
| PIC 3    |        | BUILTIN    | BUILTIN      | 12x 1GE(LAN) RJ45 |
| Fan Tray |        |            |              | Fan Tray          |

### show chassis hardware (Modular MX80 Router)

```
user@host> show chassis hardware
```

```
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               MX80
Midplane                               MX80
PEM 0                               AC Power Entry Module
Routing Engine                               Routing Engine
FEB 0                               Forwarding Engine Board

QXM 0          REV 05  711-028408  JR7041  MPC QXM
FPC 0                               MPC BUILTIN
MIC 0                               4x 10GE XFP
PIC 0                               4x 10GE XFP
FPC 1                               MPC BUILTIN
MIC 0          REV 02  750-028380  JR6598  3D 2x 10GE XFP
PIC 0                               1x 10GE XFP
Xcvr 0         REV 01  740-014289  T07M86365 XFP-10G-SR
PIC 1                               1x 10GE XFP
Xcvr 0         REV 01  740-014289  T07M71094 XFP-10G-SR
MIC 1          REV 02  750-028380  JG8548  3D 2x 10GE XFP
PIC 2                               1x 10GE XFP
Xcvr 0         REV 02  740-014289  T08L86302 XFP-10G-SR
PIC 3                               1x 10GE XFP
Xcvr 0         REV 02  740-014289  C810XU0BA XFP-10G-SR
Fan Tray                               Fan Tray
```

### show chassis hardware (MX104 Router)

```
user@host> show chassis hardware
```

```
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               MX104
Midplane          REV 28  750-044219  CAAX5741  MX104
PEM 0             REV 03  740-045933  1H072500016 AC Power Entry Module
PEM 1             REV 03  740-045932  1H073050017 DC Power Entry Module
Routing Engine 0  REV 20  750-044228  CAAY7935  RE-MX-104
Routing Engine 1 REV 13  750-044228  CAAM6380  RE-MX-104
AFEB 0                               Forwarding Engine
Processor
FPC 0                               MPC BUILTIN
FPC 1                               MPC BUILTIN
MIC 0          REV 15  750-036132  CAAF7948  2x0C12/8x0C3 CC-CE
PIC 0                               2x0C12/8x0C3 CC-CE
```

|            |        |            |           |                   |
|------------|--------|------------|-----------|-------------------|
| Xcvr 0     | REV 01 | 740-011615 | PCQ0U2J   | SFP-IR            |
| Xcvr 1     | REV 01 | 740-016068 | PJL7A6G   | SFP-SR            |
| Xcvr 2     | REV 01 | 740-016068 | PJL7A5J   | SFP-SR            |
| Xcvr 3     | REV 01 | 740-016065 | PJN5HPZ   | SFP-SR            |
| Xcvr 4     | REV 01 | 740-029122 | PKB38TL   | SFP-LR            |
| Xcvr 5     | REV 01 | 740-011787 | P6A107G   | SFP-LR            |
| Xcvr 6     | REV 01 | 740-029122 | PKB38TR   | SFP-LR            |
| Xcvr 7     | REV 01 | 740-011787 | PBKONK3   | SFP-LR            |
| MIC 1      |        |            |           |                   |
| FPC 2      |        | BUILTIN    | BUILTIN   | MPC BUILTIN       |
| MIC 0      |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| PIC 0      |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0     | REV 01 | 740-031980 | B10F00465 | SFP+-10G-SR       |
| Xcvr 1     | REV 01 | 740-031980 | B10F00461 | SFP+-10G-SR       |
| Xcvr 2     | REV 01 | 740-031980 | B10G01545 | SFP+-10G-SR       |
| Xcvr 3     | REV 01 | 740-031980 | B10G01385 | SFP+-10G-SR       |
| Fan Tray 0 | REV 02 | 711-049570 | CAAX6538  | Fan Tray          |

### show chassis hardware detail (MX104 Router)

```

user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               G3503         MX104
Midplane      REV 28    750-044219   CAAX5741      MX104
PEM 0         REV 03    740-045933   1H072500016   AC Power Entry Module
PEM 1         REV 03    740-045932   1H073050017   DC Power Entry Module
Routing Engine 0 REV 20    750-044228   CAAY7935      RE-MX-104
  da0         7836 MB  ATP IG eUSB SSD Nand Flash 0
  usb0 (addr 1) EHCI root hub 0 Freescale      uhub0
  usb0 (addr 2) USB2513Bi 9491 SMSC           uhub1
  usb0 (addr 3) ATP IG eUSB SSD 44801 ATP Electronics umass0
Routing Engine 1 REV 13    750-044228   CAAM6380      RE-MX-104
  da0         7836 MB  ATP IG eUSB SSD Nand Flash 0
AFEB 0                               BUILTIN       BUILTIN       Forwarding Engine
Processor
FPC 0                               BUILTIN       BUILTIN       MPC BUILTIN
FPC 1                               BUILTIN       BUILTIN       MPC BUILTIN
MIC 0         REV 15    750-036132   CAAF7948      2x0C12/8x0C3 CC-CE
PIC 0                               BUILTIN       BUILTIN       2x0C12/8x0C3 CC-CE
  Xcvr 0      REV 01    740-011615   PCQ0U2J      SFP-IR
  Xcvr 1      REV 01    740-016068   PJL7A6G      SFP-SR
  Xcvr 2      REV 01    740-016068   PJL7A5J      SFP-SR
  Xcvr 3      REV 01    740-016065   PJN5HPZ      SFP-SR
  Xcvr 4      REV 01    740-029122   PKB38TL      SFP-LR
  Xcvr 5      REV 01    740-011787   P6A107G      SFP-LR
  Xcvr 6      REV 01    740-029122   PKB38TR      SFP-LR
  Xcvr 7      REV 01    740-011787   PBKONK3      SFP-LR
MIC 1
FPC 2                               BUILTIN       BUILTIN       MPC BUILTIN
MIC 0                               BUILTIN       BUILTIN       4x 10GE(LAN) SFP+
PIC 0                               BUILTIN       BUILTIN       4x 10GE(LAN) SFP+
  Xcvr 0      REV 01    740-031980   B10F00465    SFP+-10G-SR
  Xcvr 1      REV 01    740-031980   B10F00461    SFP+-10G-SR
  Xcvr 2      REV 01    740-031980   B10G01545    SFP+-10G-SR
  Xcvr 3      REV 01    740-031980   B10G01385    SFP+-10G-SR
Fan Tray 0    REV 02    711-049570   CAAX6538     Fan Tray

```

### show chassis hardware extensive (MX104 Router)

```

user@host> show chassis hardware extensive

```

## Hardware inventory:

| Item    | Version | Part number | Serial number | Description |
|---------|---------|-------------|---------------|-------------|
| Chassis |         |             | G3503         | MX104       |

|              |            |                   |       |
|--------------|------------|-------------------|-------|
| Jedec Code:  | 0x7fb0     | EEPROM Version:   | 0x02  |
|              |            | S/N:              | G3503 |
| Assembly ID: | 0x0560     | Assembly Version: | 00.00 |
| Date:        | 00-00-0000 | Assembly Flags:   | 0x00  |
| ID:          | MX104      |                   |       |

## Board Information Record:

Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

## I2C Hex Data:

Address 0x00: 7f b0 02 ff 05 60 00 00 00 00 00 00 00 00 00 00  
 Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x20: 47 33 35 30 33 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
 Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

| Midplane | REV 28 | 750-044219 | CAAX5741 | MX104 |
|----------|--------|------------|----------|-------|
|----------|--------|------------|----------|-------|

|              |            |                   |                |
|--------------|------------|-------------------|----------------|
| Jedec Code:  | 0x7fb0     | EEPROM Version:   | 0x02           |
| P/N:         | 750-044219 | S/N:              | CAAX5741       |
| Assembly ID: | 0x0560     | Assembly Version: | 01.28          |
| Date:        | 03-27-2013 | Assembly Flags:   | 0x00           |
| Version:     | REV 28     | CLEI Code:        | PROTOXCLEI     |
| ID:          | MX104      | FRU Model Number: | PROTO-ASSEMBLY |

## Board Information Record:

Address 0x00: ad 01 08 00 b0 a8 6e a7 f8 00 ff ff ff ff ff ff

## I2C Hex Data:

Address 0x00: 7f b0 02 ff 05 60 01 1c 52 45 56 20 32 38 00 00  
 Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 31 39 00 00  
 Address 0x20: 53 2f 4e 20 43 41 41 58 35 37 34 31 00 1b 03 07  
 Address 0x30: dd ff ff ff ad 01 08 00 b0 a8 6e a7 f8 00 ff ff  
 Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50  
 Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00  
 Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff  
 Address 0x70: ff ff ff c2 47 33 35 30 33 00 00 00 00 00 00 00

| PEM 0 | REV 03 | 740-045933 | 1H072500016 | AC Power Entry Module |
|-------|--------|------------|-------------|-----------------------|
|-------|--------|------------|-------------|-----------------------|

|              |                       |                   |                  |
|--------------|-----------------------|-------------------|------------------|
| Jedec Code:  | 0x7fb0                | EEPROM Version:   | 0x02             |
| P/N:         | 740-045933            | S/N:              | 1H072500016      |
| Assembly ID: | 0x0475                | Assembly Version: | 00.03            |
| Date:        | 12-14-2012            | Assembly Flags:   | 0x00             |
| Version:     | REV 03                | CLEI Code:        | IPUPAJ9KAA       |
| ID:          | AC Power Entry Module | FRU Model Number: | PWR-AMX1100-AC-S |

## Board Information Record:

Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff 02 02 00 ff

## I2C Hex Data:

Address 0x00: 7f b0 02 ff 04 75 00 03 52 45 56 20 30 33 00 00  
 Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 39 33 33 00 00  
 Address 0x20: 31 48 30 37 32 35 30 30 30 31 36 00 00 0e 0c 07  
 Address 0x30: dc 30 43 ff ff ff ff ff ff ff ff ff ff ff ff ff  
 Address 0x40: 02 02 00 ff 01 49 50 55 50 41 4a 39 4b 41 41 50  
 Address 0x50: 57 52 2d 41 4d 58 31 31 30 30 2d 41 43 2d 53 00  
 Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff  
 Address 0x70: ff ff ff 70 ff ff ff ff ff ff ff ff ff ff ff ff

| PEM 1 | REV 03 | 740-045932 | 1H073050017 | DC Power Entry Module |
|-------|--------|------------|-------------|-----------------------|
|-------|--------|------------|-------------|-----------------------|

|              |            |                   |             |
|--------------|------------|-------------------|-------------|
| Jedec Code:  | 0x7fb0     | EEPROM Version:   | 0x02        |
| P/N:         | 740-045932 | S/N:              | 1H073050017 |
| Assembly ID: | 0x0476     | Assembly Version: | 00.03       |
| Date:        | 01-30-2013 | Assembly Flags:   | 0x00        |
| Version:     | REV 03     | CLEI Code:        | IPUPAJ8KAA  |

```

ID: DC Power Entry Module          FRU Model Number: PWR-AMX1100-DC-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff 02 02 00 ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 76 00 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 39 33 32 00 00
  Address 0x20: 31 48 30 37 33 30 35 30 30 31 37 00 00 1e 01 07
  Address 0x30: dd 30 44 ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: 02 02 00 ff 01 49 50 55 50 41 4a 38 4b 41 41 50
  Address 0x50: 57 52 2d 41 4d 58 31 31 30 30 2d 44 43 2d 53 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 72 ff ff ff ff ff ff ff ff ff ff ff ff
Routing Engine 0 REV 20 750-044228 CAAY7935 RE-MX-104
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-044228 S/N: CAAY7935
Assembly ID: 0x0b81 Assembly Version: 01.20
Date: 03-18-2013 Assembly Flags: 0x00
Version: REV 20 CLEI Code: PROTOXCLEI
ID: RE-MX-104 FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
  Address 0x00: ad 01 00 08 b0 a8 6e a6 fc 10 ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 fe 0b 81 01 14 52 45 56 20 32 30 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 32 38 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 59 37 39 33 35 00 12 03 07
  Address 0x30: dd ff ff ff ad 01 00 08 b0 a8 6e a6 fc 10 ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
da0 7836 MB ATP IG eUSB SSD Nand Flash 0
usb0 (addr 1) EHCI root hub 0 Freescale uhub0
usb0 (addr 2) USB2513Bi 9491 SMSC uhub1
usb0 (addr 3) ATP IG eUSB SSD 44801 ATP Electronics umass0
Routing Engine 1 REV 13 750-044228 CAAM6380 RE-MX-104
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-044228 S/N: CAAM6380
Assembly ID: 0x0b81 Assembly Version: 01.13
Date: 09-17-2012 Assembly Flags: 0x00
Version: REV 13 CLEI Code: PROTOXCLEI
ID: RE-MX-104 FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
  Address 0x00: ad 01 00 08 64 87 88 27 08 18 ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 fe 0b 81 01 0d 52 45 56 20 31 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 32 38 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 4d 36 33 38 30 00 11 09 07
  Address 0x30: dc ff ff ff ad 01 00 08 64 87 88 27 08 18 ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
da0 7836 MB ATP IG eUSB SSD Nand Flash 0
AFEB 0 BUILTIN BUILTIN Forwarding Engine
Processor
FPC 0 BUILTIN BUILTIN MPC BUILTIN
FPC 1 BUILTIN BUILTIN MPC BUILTIN
MIC 0 REV 15 750-036132 CAAF7948 2x0C12/8x0C3 CC-CE
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-036132 S/N: CAAF7948
Assembly ID: 0x0a1a Assembly Version: 01.15

```

```

Date:          07-03-2012      Assembly Flags:  0x00
Version:       REV 15         CLEI Code:      IP9IAM2DAA
ID: 2x0C12/8x0C3 CC-CE       FRU Model Number: MIC-3D-80C3-20C12-ATM
Board Information Record:
Address 0x00: 12 01 05 03 05 ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0a 1a 01 0f 52 45 56 20 31 35 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 36 31 33 32 00 00
Address 0x20: 53 2f 4e 20 43 41 41 46 37 39 34 38 00 03 07 07
Address 0x30: dc ff ff ff 12 01 05 03 05 ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 39 49 41 4d 32 44 41 41 4d
Address 0x50: 49 43 2d 33 44 2d 38 4f 43 33 2d 32 4f 43 31 32
Address 0x60: 2d 41 54 4d 00 00 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff e3 c0 02 a3 9c 00 00 00 00 0a 60 00 00
PIC 0          BUILTIN      BUILTIN      2x0C12/8x0C3 CC-CE
Xcvr 0        REV 01      740-011615    PCQOU2J      SFP-IR
Xcvr 1        REV 01      740-016068    P3L7A6G      SFP-SR
Xcvr 2        REV 01      740-016068    P3L7A5J      SFP-SR
Xcvr 3        REV 01      740-016065    PJN5HPZ      SFP-SR
Xcvr 4        REV 01      740-029122    PKB38TL      SFP-LR
Xcvr 5        REV 01      740-011787    P6A107G      SFP-LR
Xcvr 6        REV 01      740-029122    PKB38TR      SFP-LR
Xcvr 7        REV 01      740-011787    PBK0NK3      SFP-LR
MIC 1
FPC 2          BUILTIN      BUILTIN      MPC BUILTIN
MIC 0          BUILTIN      BUILTIN      4x 10GE(LAN) SFP+
Jedec Code:   0x0000      EEPROM Version: 0x00
P/N:          BUILTIN      S/N:          BUILTIN
Assembly ID:  0x0a60      Assembly Version: 00.00
Date:         00-00-0000   Assembly Flags: 0x00
ID: 4x 10GE(LAN) SFP+
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 60 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 4d 58 43 00
Address 0x20: 42 55 49 4c 54 49 4e 00 4d 58 43 00 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 a5 04 7f b0 02 ff 0a 1a 01 0f
PIC 0          BUILTIN      BUILTIN      4x 10GE(LAN) SFP+
Xcvr 0        REV 01      740-031980    B10F00465    SFP+-10G-SR
Xcvr 1        REV 01      740-031980    B10F00461    SFP+-10G-SR
Xcvr 2        REV 01      740-031980    B10G01545    SFP+-10G-SR
Xcvr 3        REV 01      740-031980    B10G01385    SFP+-10G-SR
Fan Tray 0    REV 02      711-049570    CAAX6538      Fan Tray
Jedec Code:   0x7fb0      EEPROM Version: 0x02
P/N:          711-049570   S/N:          CAAX6538
Assembly ID:  0x0b82      Assembly Version: 01.02
Date:         03-01-2013   Assembly Flags: 0x00
Version:       REV 02      CLEI Code:    PROTOXCLEI
ID: Fan Tray   FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 82 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 34 39 35 37 30 00 00
Address 0x20: 53 2f 4e 20 43 41 41 58 36 35 33 38 00 01 03 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

```

```

Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff

```

### show chassis hardware models (MX104 Router)

```

user@host> show chassis hardware models
Hardware inventory:
Item                Version  Part number  Serial number  FRU model number
Midplane            REV 20    750-044219   CAAS5849       PROTO-ASSEMBLY
PEM 0               REV 01    740-045932   1H072400065
Routing Engine 0    REV 16    750-044228   CAAR5915       PROTO-ASSEMBLY
AFEB 0              BUILTIN   BUILTIN
FPC 0               BUILTIN   BUILTIN
FPC 1               BUILTIN   BUILTIN
  MIC 0             REV 01    750-046905   CAAK7103       MIC-3D-20GE-SFP-EH
FPC 2               BUILTIN   BUILTIN
Fan Tray            REV 02    711-049570   CAAX6538       PROTO-ASSEMBLY

```

### show chassis hardware clei-models (MX104 Router)

```

user@host> show chassis hardware clei-models
Hardware inventory:
Item                Version  Part number  CLEI code      FRU model number
Midplane            REV 20    750-044219   PROTOXCLEI     PROTO-ASSEMBLY
PEM 0               REV 01    740-045932
Routing Engine 0    REV 16    750-044228   PROTOXCLEI     PROTO-ASSEMBLY
AFEB 0              BUILTIN
FPC 0               BUILTIN
FPC 1               BUILTIN
  MIC 0             REV 01    750-046905   PROTOXCLEI     MIC-3D-20GE-SFP-EH
FPC 2               BUILTIN
Fan Tray            REV 02    711-049570   CAAX6538       PROTO-ASSEMBLY

```

### show chassis hardware (MX240 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item                Version  Part number  Serial number  Description
Chassis                                     JN10C7F7EAFC  MX240
Midplane            REV 01    710-021041   TR1502         MX240 Backplane
FPM Board           REV 01    710-017254   KD4017         Front Panel Display
PEM 0               Rev 02    740-017330   000332         PS 1.2-1.7kW; 100-240V
AC in
PEM 1               Rev 02    740-017330   000226         PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0    REV 06    740-013063   1000703522     RE-S-2000
Routing Engine 1    REV 06    740-015113   1000687625     RE-S-1300
CB 0                REV 07    710-013385   KC9057         MX SCB
CB 1                REV 05    710-013385   JY4760         MX SCB
FPC 1               REV 01    750-021679   KC7340         DPCE 40x 1GE R
  CPU               REV 06    710-013713   KD4078         DPC PMB
    PIC 0            BUILTIN   BUILTIN        10x 1GE(LAN)
      Xcvr 0          REV 01    740-011613   P9F18ME        SFP-SX
    PIC 1            BUILTIN   BUILTIN        10x 1GE(LAN)
    PIC 2            BUILTIN   BUILTIN        10x 1GE(LAN)
    PIC 3            BUILTIN   BUILTIN        10x 1GE(LAN)
FPC 2               REV 04    710-016669   JS4529         DPCE 40x 1GE R EQ
  CPU               REV 06    710-013713   KB3969         DPC PMB
    PIC 0            BUILTIN   BUILTIN        10x 1GE(LAN) EQ
      Xcvr 0          REV 01    740-011613   PBG3Y79        SFP-SX

```



|            |        |            |         |                 |
|------------|--------|------------|---------|-----------------|
| Xcvr 1     | REV 01 | 740-011613 | PBG3XU8 | SFP-SX          |
| Xcvr 2     | REV 01 | 740-011613 | PBG3YG6 | SFP-SX          |
| Xcvr 3     | REV 01 | 740-011613 | PBG3XUG | SFP-SX          |
| Xcvr 4     | REV 01 | 740-011613 | PBG3XTJ | SFP-SX          |
| PIC 1      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ |
| Xcvr 0     | REV 01 | 740-011613 | PBG3ZUM | SFP-SX          |
| Xcvr 1     | REV 01 | 740-011613 | PBG3Y5H | SFP-SX          |
| Xcvr 2     | REV 01 | 740-011613 | PBG3UZT | SFP-SX          |
| Xcvr 3     | REV 01 | 740-011613 | PBG3US1 | SFP-SX          |
| PIC 2      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ |
| Xcvr 0     | REV 01 | 740-011613 | PBG3YG7 | SFP-SX          |
| Xcvr 1     | REV 01 | 740-011613 | PBG3XZ9 | SFP-SX          |
| Xcvr 2     | REV 01 | 740-011613 | PBG3XTY | SFP-SX          |
| Xcvr 3     | REV 01 | 740-011613 | PBG3UZG | SFP-SX          |
| PIC 3      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ |
| Xcvr 0     | REV 01 | 740-011613 | PBG3Y8W | SFP-SX          |
| Xcvr 1     | REV 01 | 740-011613 | PBG3YVX | SFP-SX          |
| Xcvr 2     | REV 01 | 740-011613 | PBG3YB3 | SFP-SX          |
| Xcvr 3     | REV 01 | 740-011613 | PBG43VQ | SFP-SX          |
| Fan Tray 0 | REV 01 | 710-021113 | JS4642  | MX240 Fan Tray  |

### show chassis hardware detail (MX 240 Router with Routing Engine Displaying DIMM Information)

```
user@host> show chassis hardware detail
```

| Item             | Version                            | Part number | Serial number        | Description             |
|------------------|------------------------------------|-------------|----------------------|-------------------------|
| Chassis          |                                    |             | JN11279B4AFC         | MX240 Backplane         |
| Midplane         | REV 07                             | 760-021404  | TS2474               | MX240 Backplane         |
| FPM Board        | REV 03                             | 760-021392  | XC2643               | Front Panel Display     |
| PEM 0            | Rev 03                             | 740-017343  | QCS0908A068          | DC Power Entry Module   |
| Routing Engine 0 | REV 01                             | 740-031117  | AARCH00              | RE-S-1800x4             |
| ad0 3764 MB      | STEC M2+                           | CF 9.0.2    | STIM2Q3209239145303  | Removable Compact Flash |
| ad1 28626 MB     | WDC SSD-F0030S-5000                |             | C933Z036237215548S00 | Compact Flash           |
| usb0 (addr 1)    | EHCI root hub 0                    |             | Intel                | uhub0                   |
| usb0 (addr 2)    | product 0x0020 32                  |             | vendor 0x8087        | uhub1                   |
| DIMM 0           | VL31B5263E-F8S DIE REV-0 PCB REV-0 |             |                      | MFR ID-ce80             |
| DIMM 1           | VL31B5263E-F8S DIE REV-0 PCB REV-0 |             |                      | MFR ID-ce80             |
| DIMM 2           | VL31B5263E-F8S DIE REV-0 PCB REV-0 |             |                      | MFR ID-ce80             |
| DIMM 3           | SL31B5263E-F8S DIE REV-0 PCB REV-0 |             |                      | MFR ID-ce80             |
| CB 0             | REV 03                             | 710-021523  | XD7225               | MX SCB                  |
| Fan Tray 0       | REV 01                             | 710-021113  | WZ4986               | MX240 Fan Tray          |

### show chassis hardware (MX240 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item             | Version | Part number | Serial number | Description            |
|------------------|---------|-------------|---------------|------------------------|
| Chassis          |         |             | JN10C7F7EAFC  | MX240                  |
| Midplane         | REV 01  | 710-021041  | TR1502        | MX240 Backplane        |
| FPM Board        | REV 01  | 710-017254  | KD4017        | Front Panel Display    |
| PEM 0            | Rev 02  | 740-017330  | 000332        | PS 1.2-1.7kW; 100-240V |
| AC in            |         |             |               |                        |
| PEM 1            | Rev 02  | 740-017330  | 000226        | PS 1.2-1.7kW; 100-240V |
| AC in            |         |             |               |                        |
| Routing Engine 0 | REV 06  | 740-013063  | 1000703522    | RE-S-2000              |
| Routing Engine 1 | REV 06  | 740-015113  | 1000687625    | RE-S-1300              |
| CB 0             | REV 02  | 710-031391  | YE8494        | Enhanced MX SCB        |
| CB 1             | REV 05  | 710-031391  | YOP5764       | Enhanced MX SCB        |
| FPC 1            | REV 01  | 750-021679  | KC7340        | DPCE 40x 1GE R         |
| CPU              | REV 06  | 710-013713  | KD4078        | DPC PMB                |

|            |        |            |         |                   |
|------------|--------|------------|---------|-------------------|
| PIC 0      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN)      |
| Xcvr 0     | REV 01 | 740-011613 | P9F18ME | SFP-SX            |
| PIC 1      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN)      |
| PIC 2      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN)      |
| PIC 3      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN)      |
| FPC 2      | REV 04 | 710-016669 | JS4529  | DPCE 40x 1GE R EQ |
| CPU        | REV 06 | 710-013713 | KB3969  | DPC PMB           |
| PIC 0      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ   |
| Xcvr 0     | REV 01 | 740-011613 | PBG3Y79 | SFP-SX            |
| Xcvr 1     | REV 01 | 740-011613 | PBG3XU8 | SFP-SX            |
| Xcvr 2     | REV 01 | 740-011613 | PBG3YG6 | SFP-SX            |
| Xcvr 3     | REV 01 | 740-011613 | PBG3XUG | SFP-SX            |
| Xcvr 4     | REV 01 | 740-011613 | PBG3XTJ | SFP-SX            |
| PIC 1      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ   |
| Xcvr 0     | REV 01 | 740-011613 | PBG3ZUM | SFP-SX            |
| Xcvr 1     | REV 01 | 740-011613 | PBG3Y5H | SFP-SX            |
| Xcvr 2     | REV 01 | 740-011613 | PBG3UZT | SFP-SX            |
| Xcvr 3     | REV 01 | 740-011613 | PBG3US1 | SFP-SX            |
| PIC 2      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ   |
| Xcvr 0     | REV 01 | 740-011613 | PBG3YG7 | SFP-SX            |
| Xcvr 1     | REV 01 | 740-011613 | PBG3XZ9 | SFP-SX            |
| Xcvr 2     | REV 01 | 740-011613 | PBG3XTY | SFP-SX            |
| Xcvr 3     | REV 01 | 740-011613 | PBG3UZG | SFP-SX            |
| PIC 3      |        | BUILTIN    | BUILTIN | 10x 1GE(LAN) EQ   |
| Xcvr 0     | REV 01 | 740-011613 | PBG3Y8W | SFP-SX            |
| Xcvr 1     | REV 01 | 740-011613 | PBG3YVX | SFP-SX            |
| Xcvr 2     | REV 01 | 740-011613 | PBG3YB3 | SFP-SX            |
| Xcvr 3     | REV 01 | 740-011613 | PBG43VQ | SFP-SX            |
| Fan Tray 0 | REV 01 | 710-021113 | JS4642  | MX240 Fan Tray    |

#### show chassis hardware (MX480 Router)

```
user@host> show chassis hardware
```

| Hardware inventory: |         |             |               |                        |
|---------------------|---------|-------------|---------------|------------------------|
| Item                | Version | Part number | Serial number | Description            |
| Chassis             |         |             | JN10C7F7FAFB  | MX480                  |
| Midplane            | REV 04  | 710-017414  | TR2071        | MX480 Midplane         |
| FPM Board           | REV 02  | 710-017254  | KB8459        | Front Panel Display    |
| PEM 0               | Rev 02  | 740-017330  | QCS07519029   | PS 1.2-1.7kW; 100-240V |
| AC in               |         |             |               |                        |
| PEM 1               | Rev 02  | 740-017330  | QCS07519041   | PS 1.2-1.7kW; 100-240V |
| AC in               |         |             |               |                        |
| PEM 2               | Rev 02  | 740-017330  | QCS07519097   | PS 1.2-1.7kW; 100-240V |
| AC in               |         |             |               |                        |
| Routing Engine 0    | REV 07  | 740-013063  | 1000733381    | RE-S-2000              |
| Routing Engine 1    | REV 07  | 740-013063  | 1000733540    | RE-S-2000              |
| CB 0                | REV 07  | 710-013385  | KA8022        | MX SCB                 |
| CB 1                | REV 07  | 710-013385  | KA8303        | MX SCB                 |
| FPC 0               | REV 09  | 750-020452  | KA8660        | DPCE 40x 1GE X EQ      |
| CPU                 | REV 06  | 710-013713  | KA8185        | DPC PMB                |
| PIC 0               |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| PIC 1               |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| PIC 2               |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| PIC 3               |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| Fan Tray            |         |             |               | Left Fan Tray          |

#### show chassis hardware (MX480 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
```

| Hardware inventory: |         |             |               |             |
|---------------------|---------|-------------|---------------|-------------|
| Item                | Version | Part number | Serial number | Description |

|                  |        |            |              |                        |
|------------------|--------|------------|--------------|------------------------|
| Chassis          |        |            | JN10C7F7FAFB | MX480                  |
| Midplane         | REV 04 | 710-017414 | TR2071       | MX480 Midplane         |
| FPM Board        | REV 02 | 710-017254 | KB8459       | Front Panel Display    |
| PEM 0            | Rev 02 | 740-017330 | QCS07519029  | PS 1.2-1.7kW; 100-240V |
| AC in            |        |            |              |                        |
| PEM 1            | Rev 02 | 740-017330 | QCS07519041  | PS 1.2-1.7kW; 100-240V |
| AC in            |        |            |              |                        |
| PEM 2            | Rev 02 | 740-017330 | QCS07519097  | PS 1.2-1.7kW; 100-240V |
| AC in            |        |            |              |                        |
| Routing Engine 0 | REV 07 | 740-013063 | 1000733381   | RE-S-2000              |
| Routing Engine 1 | REV 07 | 740-013063 | 1000733540   | RE-S-2000              |
| CB 0             | REV 07 | 710-013385 | KA8022       | Enhanced MX SCB        |
| CB 1             | REV 07 | 710-013385 | KA8303       | Enhanced MX SCB        |
| FPC 0            | REV 09 | 750-020452 | KA8660       | DPCE 40x 1GE X EQ      |
| CPU              | REV 06 | 710-013713 | KA8185       | DPC PMB                |
| PIC 0            |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) EQ        |
| PIC 1            |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) EQ        |
| PIC 2            |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) EQ        |
| PIC 3            |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) EQ        |
| Fan Tray         |        |            |              | Left Fan Tray          |

#### show chassis hardware (MX480 Routers with MPC5E and Built-in OTN PIC)

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description            |
|------------------|---------|-------------|---------------|------------------------|
| Chassis          |         |             | JN11C0338AFB  | MX480                  |
| Midplane         | REV 05  | 710-017414  | ABAB8430      | MX480 Midplane         |
| FPM Board        | REV 02  | 710-017254  | ZS8005        | Front Panel Display    |
| PEM 0            | Rev 05  | 740-029970  | QCS1024U089   | PS 1.4-2.52kW; 90-264V |
| AC in            |         |             |               |                        |
| PEM 1            | Rev 10  | 740-029970  | QCS1314U0FJ   | PS 1.4-2.52kW; 90-264V |
| AC in            |         |             |               |                        |
| PEM 2            | Rev 07  | 740-029970  | QCS1121U076   | PS 1.4-2.52kW; 90-264V |
| AC in            |         |             |               |                        |
| Routing Engine 0 | REV 05  | 740-031116  | 9009092471    | RE-S-1800x4            |
| Routing Engine 1 | REV 05  | 740-031116  | 9009097958    | RE-S-1800x4            |
| CB 0             | REV 16  | 750-031391  | CAAX0789      | Enhanced MX SCB        |
| CB 1             | REV 16  | 750-031391  | CAAX0856      | Enhanced MX SCB        |
| FPC 0            | REV 32  | 750-028467  | ABBP1782      | MPC 3D 16x 10GE        |
| CPU              | REV 10  | 711-029089  | ABBP5410      | AMPC PMB               |
| PIC 0            |         | BUILTIN     | BUILTIN       | 4x 10GE(LAN) SFP+      |
| Xcvr 0           | REV 01  | 740-021308  | 983152A00038  | SFP+-10G-SR            |
| Xcvr 1           | REV 01  | 740-031980  | B11F00211     | SFP+-10G-SR            |
| Xcvr 2           | REV 01  | 740-031980  | AQ72LPB       | SFP+-10G-SR            |
| Xcvr 3           | REV 01  | 740-031980  | AHNOWR5       | SFP+-10G-SR            |
| PIC 1            |         | BUILTIN     | BUILTIN       | 4x 10GE(LAN) SFP+      |
| Xcvr 0           | REV 01  | 740-031980  | B11J03627     | SFP+-10G-SR            |
| Xcvr 1           | REV 01  | 740-031980  | B11F00300     | SFP+-10G-SR            |
| Xcvr 2           | REV 01  | 740-021308  | AQ42WSS       | SFP+-10G-SR            |
| Xcvr 3           | REV 01  | 740-021308  | AQ43HGC       | SFP+-10G-SR            |
| PIC 2            |         | BUILTIN     | BUILTIN       | 4x 10GE(LAN) SFP+      |
| Xcvr 0           | REV 01  | 740-021308  | ANAONDO       | SFP+-10G-SR            |
| Xcvr 1           | REV 01  | 740-021308  | ANAONGF       | SFP+-10G-SR            |
| Xcvr 2           | REV 01  | 740-021308  | ANAONG9       | SFP+-10G-SR            |
| Xcvr 3           | REV 01  | 740-021308  | ANAOMP9       | SFP+-10G-SR            |
| PIC 3            |         | BUILTIN     | BUILTIN       | 4x 10GE(LAN) SFP+      |
| Xcvr 0           | REV 01  | 740-021308  | AQA06CG       | SFP+-10G-SR            |
| Xcvr 1           | REV 01  | 740-021308  | 19T511100493  | SFP+-10G-SR            |
| Xcvr 2           | REV 01  | 740-031980  | APR040J       | SFP+-10G-SR            |
| FPC 1            | REV 26  | 750-046005  | CACN1894      | MPC5E 3D Q 2CGE+4XGE   |

|          |             |            |              |                        |
|----------|-------------|------------|--------------|------------------------|
| CPU      | REV 09      | 711-045719 | CACN8698     | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN        |
| Xcvr 0   | REV 01      | 740-031980 | 163363A03046 | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-031980 | AJ40JS8      | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN        |
| Xcvr 0   | REV 01      | 740-031980 | 153363A00593 | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-031980 | AJ40J0J      | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN       |
| Xcvr 0   |             | NON-JNPR   | UQC0B53      | CFP2-100G-LR4-D        |
| FPC 2    | REV 26      | 750-046005 | CACN1891     | MPC5E 3D Q 2CGE+4XGE   |
| CPU      | REV 09      | 711-045719 | CACN8694     | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN        |
| Xcvr 0   |             | NON-JNPR   | URA012A      | SFP+-10G-LR            |
| PIC 1    |             | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN       |
| Xcvr 0   |             | NON-JNPR   | J13F47042    | CFP2-100G-LR4-D        |
| PIC 2    |             | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN        |
| Xcvr 0   | REV 01      | 740-031980 | AJC0BM3      | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | 11T511100917 | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN       |
| Xcvr 0   |             | NON-JNPR   | UQK07SU      | CFP2-100G-LR4-D        |
| FPC 3    | REV 03      | 750-045372 | CAAD9425     | MPCE Type 3 3D         |
| CPU      | REV 08      | 711-035209 | CAAD9094     | HMPD PMB 2G            |
| MIC 0    | REV 14      | 750-033196 | CAAW9204     | 1X100GE CXP            |
| PIC 0    |             | BUILTIN    | BUILTIN      | 1X100GE CXP            |
| Xcvr 0   | REV 01      | 740-046563 | XD16FC034    | CFP2-100G-SR10         |
| MIC 1    | REV 19      | 750-033199 | CAAJ1814     | 1X100GE CFP            |
| PIC 2    |             | BUILTIN    | BUILTIN      | 1X100GE CFP            |
| FPC 4    | REV 21.0.11 | 750-045715 | CAAY3568     | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 07      | 711-045719 | CAAW7430     | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| Xcvr 0   | REV 01      | 740-031980 | AP406NG      | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AR41NLP      | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-031980 | B11D05630    | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN      | 3X40GE QSFP            |
| PIC 3    |             | BUILTIN    | BUILTIN      | 3X40GE QSFP            |
| WAN MEZZ | REV 12      | 750-049136 | CACM6678     | MPC5E 24XGE OTN Mezz   |
| FPC 5    | REV 11      | 750-045372 | CABK7539     | MPCE Type 3 3D         |
| CPU      | REV 08      | 711-035209 | CABJ2466     | HMPD PMB 2G            |
| MIC 0    | REV 19      | 750-033199 | CAAJ9719     | 1X100GE CFP            |
| PIC 0    |             | BUILTIN    | BUILTIN      | 1X100GE CFP            |
| Xcvr 0   | REV 01      | 740-035329 | UP1020P      | CFP-100G-SR10          |
| MIC 1    | REV 07      | 750-033196 | YZ0797       | 1X100GE CXP            |
| PIC 2    |             | BUILTIN    | BUILTIN      | 1X100GE CXP            |
| Xcvr 0   | REV 01      | 740-046563 | XC42FC022    | CFP2-100G-SR10         |
| Fan Tray |             |            |              | Enhanced Left Fan Tray |

### show chassis hardware detail (MX480 Routers with MPC5E and Built-in OTN PIC)

```
user@host> show chassis hardware detail
```

| Hardware inventory: |         |             |               |                        |
|---------------------|---------|-------------|---------------|------------------------|
| Item                | Version | Part number | Serial number | Description            |
| Chassis             |         |             | JN11C0338AFB  | MX480                  |
| Midplane            | REV 05  | 710-017414  | ABAB8430      | MX480 Midplane         |
| FPM Board           | REV 02  | 710-017254  | ZS8005        | Front Panel Display    |
| PEM 0               | Rev 05  | 740-029970  | QCS1024U089   | PS 1.4-2.52kW; 90-264V |
| AC in               |         |             |               |                        |
| PEM 1               | Rev 10  | 740-029970  | QCS1314U0FJ   | PS 1.4-2.52kW; 90-264V |
| AC in               |         |             |               |                        |
| PEM 2               | Rev 07  | 740-029970  | QCS1121U076   | PS 1.4-2.52kW; 90-264V |

```

AC in
Routing Engine 0 REV 05 740-031116 9009092471 RE-S-1800x4
ad0 3896 MB VRFCF14096DIHK1 VM4096MB 6862 Compact Flash
ad1 30533 MB UGB94ARF32H0S3-KC UNIGEN-478612-001127 Disk 1
usb0 (addr 1) EHCI root hub 0 Intel uhub0
usb0 (addr 2) product 0x0020 32 vendor 0x8087 uhub1
DIMM 0 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 1 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 2 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 3 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 05 740-031116 9009097958 RE-S-1800x4
ad0 3896 MB VRFCF14096DIHK1 VM4096MB 6145 Compact Flash
ad1 30533 MB UGB94ARF32H0S3-KC UNIGEN-499551-000273 Disk 1
CB 0 REV 16 750-031391 CAAX0789 Enhanced MX SCB
CB 1 REV 16 750-031391 CAAX0856 Enhanced MX SCB
FPC 0 REV 32 750-028467 ABBP1782 MPC 3D 16x 10GE
CPU REV 10 711-029089 ABBP5410 AMPC PMB
PIC 0 BUILTIN BUILTIN 4x 10GE(LAN) SFP+
Xcvr 0 REV 01 740-021308 983152A00038 SFP+-10G-SR
Xcvr 1 REV 01 740-031980 B11F00211 SFP+-10G-SR
Xcvr 2 REV 01 740-031980 AQ72LPB SFP+-10G-SR
Xcvr 3 REV 01 740-031980 AHNOWR5 SFP+-10G-SR
PIC 1 BUILTIN BUILTIN 4x 10GE(LAN) SFP+
Xcvr 0 REV 01 740-031980 B11J03627 SFP+-10G-SR
Xcvr 1 REV 01 740-031980 B11F00300 SFP+-10G-SR
Xcvr 2 REV 01 740-021308 AQ42WSS SFP+-10G-SR
Xcvr 3 REV 01 740-021308 AQ43HGC SFP+-10G-SR
PIC 2 BUILTIN BUILTIN 4x 10GE(LAN) SFP+
Xcvr 0 REV 01 740-021308 ANAOND0 SFP+-10G-SR
Xcvr 1 REV 01 740-021308 ANAONGF SFP+-10G-SR
Xcvr 2 REV 01 740-021308 ANAONG9 SFP+-10G-SR
Xcvr 3 REV 01 740-021308 ANAOMP9 SFP+-10G-SR
PIC 3 BUILTIN BUILTIN 4x 10GE(LAN) SFP+
Xcvr 0 REV 01 740-021308 AQA06CG SFP+-10G-SR
Xcvr 1 REV 01 740-021308 19T511100493 SFP+-10G-SR
Xcvr 2 REV 01 740-031980 APR040J SFP+-10G-SR
FPC 1 REV 26 750-046005 CACN1894 MPC5E 3D Q 2CGE+4XGE
CPU REV 09 711-045719 CACN8698 RMPC PMB
PIC 0 BUILTIN BUILTIN 2X10GE SFPP OTN
Xcvr 0 REV 01 740-031980 163363A03046 SFP+-10G-SR
Xcvr 1 REV 01 740-031980 AJ40JS8 SFP+-10G-SR
PIC 1 BUILTIN BUILTIN 1X100GE CFP2 OTN
PIC 2 BUILTIN BUILTIN 2X10GE SFPP OTN
Xcvr 0 REV 01 740-031980 153363A00593 SFP+-10G-SR
Xcvr 1 REV 01 740-031980 AJ40JUJ SFP+-10G-SR
PIC 3 BUILTIN BUILTIN 1X100GE CFP2 OTN
Xcvr 0 NON-JNPR UQC0B53 CFP2-100G-LR4-D
FPC 2 REV 26 750-046005 CACN1891 MPC5E 3D Q 2CGE+4XGE
CPU REV 09 711-045719 CACN8694 RMPC PMB
PIC 0 BUILTIN BUILTIN 2X10GE SFPP OTN
Xcvr 0 NON-JNPR URA012A SFP+-10G-LR
PIC 1 BUILTIN BUILTIN 1X100GE CFP2 OTN
Xcvr 0 NON-JNPR J13F47042 CFP2-100G-LR4-D
PIC 2 BUILTIN BUILTIN 2X10GE SFPP OTN
Xcvr 0 REV 01 740-031980 AJC0BM3 SFP+-10G-SR
Xcvr 1 REV 01 740-021308 11T511100917 SFP+-10G-SR
PIC 3 BUILTIN BUILTIN 1X100GE CFP2 OTN
Xcvr 0 NON-JNPR UQK07SU CFP2-100G-LR4-D
FPC 3 REV 03 750-045372 CAAD9425 MPCE Type 3 3D
CPU REV 08 711-035209 CAAD9094 HMPCE PMB 2G
MIC 0 REV 14 750-033196 CAAW9204 1X100GE CXP

```

|          |             |            |           |                        |
|----------|-------------|------------|-----------|------------------------|
| PIC 0    |             | BUILTIN    | BUILTIN   | 1X100GE CXP            |
| Xcvr 0   | REV 01      | 740-046563 | XD16FC034 | CFP2-100G-SR10         |
| MIC 1    | REV 19      | 750-033199 | CAAJ1814  | 1X100GE CFP            |
| PIC 2    |             | BUILTIN    | BUILTIN   | 1X100GE CFP            |
| FPC 4    | REV 21.0.11 | 750-045715 | CAAY3568  | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 07      | 711-045719 | CAAW7430  | RMPC PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN   | 12X10GE SFPP OTN       |
| Xcvr 0   | REV 01      | 740-031980 | AP406NG   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AR41NLP   | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-031980 | B11D05630 | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN   | 12X10GE SFPP OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN   | 3X40GE QSFP            |
| PIC 3    |             | BUILTIN    | BUILTIN   | 3X40GE QSFP            |
| WAN MEZZ | REV 12      | 750-049136 | CACM6678  | MPC5E 24XGE OTN Mezz   |
| FPC 5    | REV 11      | 750-045372 | CABK7539  | MPCE Type 3 3D         |
| CPU      | REV 08      | 711-035209 | CABJ2466  | HMPC PMB 2G            |
| MIC 0    | REV 19      | 750-033199 | CAAJ9719  | 1X100GE CFP            |
| PIC 0    |             | BUILTIN    | BUILTIN   | 1X100GE CFP            |
| Xcvr 0   | REV 01      | 740-035329 | UP1020P   | CFP-100G-SR10          |
| MIC 1    | REV 07      | 750-033196 | YZ0797    | 1X100GE CXP            |
| PIC 2    |             | BUILTIN    | BUILTIN   | 1X100GE CXP            |
| Xcvr 0   | REV 01      | 740-046563 | XC42FC022 | CFP2-100G-SR10         |
| Fan Tray |             |            |           | Enhanced Left Fan Tray |

#### show chassis hardware extensive (MX480 Routers with MPC5E and Built-in OTN PIC)

```

user@host> show chassis hardware extensive
Hardware inventory:
Item              Version  Part number  Serial number  Description
Chassis
Jedec Code:      0x7fb0          EEPROM Version: 0x02
S/N:             JN11C0338AFB
Assembly ID:     0x01fe          Assembly Version: 00.00
Date:            00-00-0000      Assembly Flags:  0x02
ID: MX480
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 01 fe 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: 4a 4e 31 31 43 30 33 33 38 41 46 42 02 00 00 00
Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane          REV 05  710-017414  ABAB8430      MX480 Midplane
Jedec Code:      0x7fb0          EEPROM Version: 0x01
P/N:             710-017414      S/N:          ABAB8430
Assembly ID:     0x01fe          Assembly Version: 01.05
Date:            12-13-2011      Assembly Flags: 0x00
Version:         REV 05
ID: MX480 Midplane          FRU Model Number: CHAS-BP-MX480-S
Board Information Record:
Address 0x00: ad 01 08 00 00 23 9c fc 98 00 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 01 fe 01 05 52 45 56 20 30 35 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 31 37 34 31 34 00 00
Address 0x20: 53 2f 4e 20 41 42 41 42 38 34 33 30 00 0d 0c 07
Address 0x30: db ff ff ff ad 01 08 00 00 23 9c fc 98 00 ff ff

```

```

Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 43
Address 0x50: 48 41 53 2d 42 50 2d 4d 58 34 38 30 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

FPM Board          REV 02    710-017254    ZS8005          Front Panel Display
Jedec Code:       0x7fb0          EEPROM Version: 0x01
P/N:              710-017254      S/N:           ZS8005
Assembly ID:      0x01ff          Assembly Version: 01.02
Date:             11-21-2011      Assembly Flags: 0x00
Version:          REV 02
ID: Front Panel Display          FRU Model Number: CRAFT-MX480-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 01 ff 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 31 37 32 35 34 00 00
Address 0x20: 53 2f 4e 20 5a 53 38 30 30 35 00 00 00 15 0b 07
Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 43
Address 0x50: 52 41 46 54 2d 4d 58 34 38 30 2d 53 00 00 00 00
Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

PEM 0              Rev 05    740-029970    QCS1024U089    PS 1.4-2.52kW; 90-264V
AC in
Jedec Code:       0x7fb0          EEPROM Version: 0x01
P/N:              740-029970      S/N:           QCS1024U089
Assembly ID:      0x0432          Assembly Version: 01.05
Date:             06-17-2010      Assembly Flags: 0x00
Version:          Rev 05
ID: PS 1.4-2.52kW; 90-264V AC in FRU Model Number: PWR-MX480-2520-AC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 32 01 05 52 65 76 20 30 35 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 32 39 39 37 30 00 00
Address 0x20: 51 43 53 31 30 32 34 55 30 38 39 00 00 11 06 07
Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
Address 0x50: 57 52 2d 4d 58 34 38 30 2d 32 35 32 30 2d 41 43
Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

PEM 1              Rev 10    740-029970    QCS1314U0FJ    PS 1.4-2.52kW; 90-264V
AC in
Jedec Code:       0x7fb0          EEPROM Version: 0x01
P/N:              740-029970      S/N:           QCS1314U0FJ
Assembly ID:      0x0432          Assembly Version: 01.10
Date:             04-04-2013      Assembly Flags: 0x00
Version:          Rev 10
ID: PS 1.4-2.52kW; 90-264V AC in FRU Model Number: PWR-MX480-2520-AC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 32 01 0a 52 65 76 20 31 30 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 32 39 39 37 30 00 00
Address 0x20: 51 43 53 31 33 31 34 55 30 46 4a 00 00 04 04 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
Address 0x50: 57 52 2d 4d 58 34 38 30 2d 32 35 32 30 2d 41 43
Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

PEM 2              Rev 07    740-029970    QCS1121U076    PS 1.4-2.52kW; 90-264V

```

```

AC in
Jedec Code: 0x7fb0          EEPROM Version: 0x01
P/N: 740-029970          S/N: QCS1121U076
Assembly ID: 0x0432        Assembly Version: 01.07
Date: 05-23-2011          Assembly Flags: 0x00
Version: Rev 07
ID: PS 1.4-2.52kW; 90-264V AC in FRU Model Number: PWR-MX480-2520-AC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 32 01 07 52 65 76 20 30 37 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 32 39 39 37 30 00 00
Address 0x20: 51 43 53 31 31 32 31 55 30 37 36 00 00 17 05 07
Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
Address 0x50: 57 52 2d 4d 58 34 38 30 2d 32 35 32 30 2d 41 43
Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Routing Engine 0 REV 05 740-031116 9009092471 RE-S-1800x4
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-031116          S/N: 9009092471
Assembly ID: 0x09c0        Assembly Version: 01.05
Date: 11-01-2011          Assembly Flags: 0x00
Version: REV 05           CLEI Code: COUCALDBAA
ID: RE-S-1800x4           FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:
Address 0x00: 54 32 30 32 37 43 41 2d 34 32 46 42 23 23 23 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 05 52 45 56 20 30 35 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 31 31 31 36 00 00
Address 0x20: 39 30 30 39 30 39 32 34 37 31 00 00 00 01 0b 07
Address 0x30: db ff ff ff 54 32 30 32 37 43 41 2d 34 32 46 42
Address 0x40: 23 23 23 00 01 43 4f 55 43 41 4c 44 42 41 41 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 4b ff ff ff ff ff ff ff ff ff ff ff ff
ad0 3896 MB VRFCF14096DIHK1 VM4096MB 6862 Compact Flash
ad1 30533 MB UGB94ARF32H0S3-KC UNIGEN-478612-001127 Disk 1
usb0 (addr 1) EHCI root hub 0 Intel uhub0
usb0 (addr 2) product 0x0020 32 vendor 0x8087 uhub1
DIMM 0 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 1 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 2 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 3 SGU04G72H1BB2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 05 740-031116 9009097958 RE-S-1800x4
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-031116          S/N: 9009097958
Assembly ID: 0x09c0        Assembly Version: 01.05
Date: 02-06-2012          Assembly Flags: 0x00
Version: REV 05           CLEI Code: COUCALDBAA
ID: RE-S-1800x4           FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:
Address 0x00: 54 32 30 32 37 43 41 2d 34 32 46 42 23 23 23 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 05 52 45 56 20 30 35 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 31 31 31 36 00 00
Address 0x20: 39 30 30 39 30 39 37 39 35 38 00 00 00 06 02 07
Address 0x30: dc ff ff ff 54 32 30 32 37 43 41 2d 34 32 46 42
Address 0x40: 23 23 23 00 01 43 4f 55 43 41 4c 44 42 41 41 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff

```



```

Address 0x70: ff ff ff 4b ff ff ff ff ff ff ff ff ff ff ff
ad0      3896 MB VRFCF14096DIHK1      VM4096MB 6145      Compact Flash
ad1      30533 MB UGB94ARF32H0S3-KC    UNIGEN-499551-000273 Disk 1

```

...

### show chassis hardware (MX960 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               MX960
Midplane                               MX960 Midplane
PIM                               Power Inlet Module
PEM 2
PEM 3                               PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 00    740-015113    1000617944    RE-S-1300
CB 0                               MX960 Test SCB
FPC 4                               MX960 Test DPC
CPU
PIC 0                               1x 10GE (LAN/WAN)
PIC 1                               10x 1GE
FPC 7                               MX960 Test DPC
CPU
PIC 0                               1x 10GE (LAN/WAN)
Xcvr 0                               XFP-10G-SR
PIC 1                               10x 1GE
Xcvr 1                               SFP-SX
Xcvr 4                               SFP-SX
Xcvr 6                               SFP-SX
Xcvr 9                               SFP-SX
Fan Tray 0
Fan Tray 1

```

### show chassis hardware (MX960 Router with Bidirectional Optics)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               MX960
Midplane                               MX960 Backplane
FPM Board                               Front Panel Display
PDM                               Power Distribution Module
PEM 0                               PS 1.7kW; 200-240VAC in
PEM 1                               PS 1.7kW; 200-240VAC in
PEM 2                               PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 06    740-013063    1000691458    RE-S-2000
CB 0                               MX SCB
CB 1                               MX SCB
FPC 3                               DPCE 40x 1GE R
CPU
FPC 4                               DPCE 40x 1GE R
CPU                               DPC PMB
PIC 0                               10x 1GE (LAN)
Xcvr 1                               SFP-1000BASE-BX40-D
Xcvr 2                               SFP-1000BASE-BX40-D
Xcvr 5                               SFP-1000BASE-BX10-U
Xcvr 6                               SFP-1000BASE-BX40-U
Xcvr 8                               SFP-1000BASE-BX40-U
PIC 1                               10x 1GE (LAN)
Xcvr 0                               SFP-1000BASE-BX10-D

```

|            |        |            |              |                     |
|------------|--------|------------|--------------|---------------------|
| Xcvr 1     | REV 01 | 740-020465 | 75E467X00818 | SFP-1000BASE-BX10-D |
| Xcvr 2     | REV 01 | 740-020465 | 75E467X00573 | SFP-1000BASE-BX10-D |
| Xcvr 3     | REV 01 | 740-020465 | 4888227      | SFP-1000BASE-BX10-D |
| Xcvr 4     | REV 01 | 740-020465 | 4888241      | SFP-1000BASE-BX10-D |
| Xcvr 5     | REV 01 | 740-021340 | 77E245N00005 | SFP-1000BASE-BX10-U |
| Xcvr 6     | REV 01 | 740-021340 | 76E245X00487 | SFP-1000BASE-BX10-U |
| Xcvr 7     | REV 01 | 740-021341 | 5255889      | SFP-1000BASE-BX10-U |
| Xcvr 8     | REV 01 | 740-021341 | 5255887      | SFP-1000BASE-BX10-U |
| Xcvr 9     | REV 01 | 740-021340 | 77E245N00004 | SFP-1000BASE-BX10-U |
| PIC 2      |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN)        |
| Xcvr 0     | REV 01 | 740-020424 | 5007582      | SFP-1000BASE-BX10-D |
| Xcvr 1     | REV 01 | 740-020424 | 4888187      | SFP-1000BASE-BX10-D |
| Xcvr 2     | REV 01 | 740-020424 | 4656500      | SFP-1000BASE-BX10-D |
| Xcvr 5     | REV 01 | 740-021341 | 5255886      | SFP-1000BASE-BX10-U |
| Xcvr 7     | REV 01 | 740-021340 | 77E245N00003 | SFP-1000BASE-BX10-U |
| Xcvr 8     | REV 01 | 740-021341 | 5255888      | SFP-1000BASE-BX10-U |
| PIC 3      |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN)        |
| Xcvr 0     | REV 01 | 740-017726 | 74S184H30341 | SFP-EX              |
| Xcvr 1     | REV 01 | 740-017726 | 4814061      | SFP-EX              |
| Xcvr 5     | REV 01 | 740-017726 | 6ZS184H31108 | SFP-EX              |
| Xcvr 9     | REV 01 | 740-021340 | 76E245X00486 | SFP-1000BASE-BX10-U |
| Fan Tray 0 |        |            |              |                     |
| Fan Tray 1 | REV 03 | 740-014971 | TP0850       | Fan Tray            |

## show chassis hardware (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
```

| Hardware inventory: |         |             |                 |                           |
|---------------------|---------|-------------|-----------------|---------------------------|
| Item                | Version | Part number | Serial number   | Description               |
| Chassis             |         |             | JN1096805AFA    | MX960                     |
| Midplane            | REV 03  | 710-013698  | TR0183          | MX960 Backplane           |
| Fan Extender        | REV 02  | 710-018051  | JY5227          | Extended Cable Manager    |
| FPM Board           | REV 03  | 710-014974  | JZ6876          | Front Panel Display       |
| PDM                 | Rev 03  | 740-013110  | QCS11035023     | Power Distribution Module |
| PEM 1               | Rev 03  | 740-013682  | QCS1109400L     | PS 1.7kW; 200-240VAC in   |
| PEM 2               | Rev 03  | 740-013682  | QCS11094015     | PS 1.7kW; 200-240VAC in   |
| PEM 3               | Rev 03  | 740-013682  | QCS11094012     | PS 1.7kW; 200-240VAC in   |
| Routing Engine 0    | REV 06  | 740-013063  | 1000687969      | RE-S-2000                 |
| Routing Engine 1    | REV 06  | 740-013063  | 1000687955      | RE-S-2000                 |
| CB 0                | REV 11  | 750-031391  | YZ6072          | Enhanced MX SCB           |
| CB 1                | REV 11  | 750-031391  | YZ6068          | Enhanced MX SCB           |
| CB 2                | REV 11  | 750-031391  | YZ6081          | Enhanced MX SCB           |
| FPC 0               | REV 01  | 750-018122  | KA5576          | DPCE 40x 1GE R            |
| CPU                 | REV 06  | 710-013713  | KB3961          | DPC PMB                   |
| PIC 0               |         | BUILTIN     | BUILTIN         | 10x 1GE(LAN)              |
| Xcvr 0              | REV 01  | 740-011613  | P9F18GF         | SFP-SX                    |
| Xcvr 2              | REV 01  | 740-011782  | P9M0TL9         | SFP-SX                    |
| Xcvr 7              | REV 01  | 740-011782  | P9P0XXH         | SFP-SX                    |
| Xcvr 9              | REV 01  | 740-011782  | P9M0TN1         | SFP-SX                    |
| PIC 1               |         | BUILTIN     | BUILTIN         | 10x 1GE(LAN)              |
| Xcvr 0              | REV 01  | 740-011613  | PAJ4UHC         | SFP-SX                    |
| PIC 2               |         | BUILTIN     | BUILTIN         | 10x 1GE(LAN)              |
| Xcvr 0              | REV 01  | 740-011613  | PFF2CD0         | SFP-SX                    |
| Xcvr 1              | REV 01  | 740-011613  | PBG3ZUT         | SFP-SX                    |
| Xcvr 2              | REV 01  | 740-011613  | PFF2DDV         | SFP-SX                    |
| Xcvr 5              | REV 01  | 740-011613  | P8E2SST         | SFP-SX                    |
| Xcvr 9              | REV 01  | 740-011782  | PB8329N         | SFP-SX                    |
| PIC 3               |         | BUILTIN     | BUILTIN         | 10x 1GE(LAN)              |
| Xcvr 0              | REV 01  | 740-026192  | 1U0201084503342 | SFP-100BASE-BX10-U        |
| Xcvr 1              | REV 01  | 740-026193  | 1U1201084503313 | SFP-100BASE-BX10-D        |
| Xcvr 2              | REV 01  | 740-011613  | PAJ4Y5B         | SFP-SX                    |

|        |        |            |              |                      |
|--------|--------|------------|--------------|----------------------|
| Xcvr 6 | REV 01 | 740-011782 | P9M0U3M      | SFP-SX               |
| Xcvr 7 | REV 01 | 740-011782 | P9M0TLA      | SFP-SX               |
| FPC 1  | REV 16 | 750-031089 | YL0719       | MPC Type 2 3D        |
| CPU    | REV 06 | 711-030884 | YL1463       | MPC PMB 2G           |
| MIC 0  | REV 07 | 750-028387 | JR6500       | 3D 4x 10GE XFP       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| Xcvr 0 | REV 01 | 740-014279 | 733019A00154 | XFP-10G-LR           |
| Xcvr 1 | REV 02 | 740-014289 | T09F55034    | XFP-10G-SR           |
| PIC 1  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| Xcvr 0 | REV 01 | 740-014279 | 913019B00791 | XFP-10G-LR           |
| Xcvr 1 | REV 01 | 740-014289 | 98S803A90384 | XFP-10G-SR           |
| MIC 1  | REV 24 | 750-028387 | YJ3950       | 3D 4x 10GE XFP       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| Xcvr 0 | REV 02 | 740-014279 | T10B36134    | XFP-10G-LR           |
| Xcvr 1 | REV 01 | 740-014289 | T07M86354    | XFP-10G-SR           |
| PIC 3  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| FPC 2  | REV 08 | 710-014219 | JY9654       | DPCE 4x 10GE R       |
| CPU    | REV 06 | 710-013713 | JZ6549       | DPC PMB              |
| PIC 0  |        | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN)     |
| PIC 1  |        | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN)     |
| PIC 2  |        | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN)     |
| Xcvr 0 | REV 03 | 740-011571 | C931BK028    | XFP-10G-SR           |
| PIC 3  |        | BUILTIN    | BUILTIN      | 1x 10GE(LAN/WAN)     |
| FPC 3  | REV 10 | 750-024199 | XJ6692       | MX FPC Type 3        |
| CPU    | REV 03 | 710-022351 | XF5182       | DPC PMB              |
| PIC 0  | REV 17 | 750-009553 | RJ2945       | 4x OC-48 SONET       |
| Xcvr 1 | REV 01 | 740-011785 | PCP3YLL      | SFP-SR               |
| Xcvr 3 | REV 01 | 740-011785 | PDSOMRY      | SFP-SR               |
| PIC 1  | REV 32 | 750-003700 | DP2113       | 1x OC-192 12xMM VSR  |
| FPC 5  | REV 25 | 750-028467 | YM8256       | MPC 3D 16x 10GE      |
| CPU    | REV 10 | 711-029089 | YL3029       | AMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+    |
| Xcvr 1 | REV 01 | 740-031980 | AHNOX1Z      | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+    |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+    |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+    |
| FPC 7  | REV 02 | 750-031092 | JR6658       | MPC Type 1 3D Q      |
| CPU    | REV 01 | 711-030884 | JZ9038       | MPC PMB 2G           |
| MIC 0  | REV 08 | 750-028392 | JZ8737       | 3D 20x 1GE(LAN) SFP  |
| PIC 0  |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) SFP     |
| Xcvr 0 | REV 01 | 740-011782 | PBE2C6Y      | SFP-SX               |
| Xcvr 2 |        | NON-JNPR   | U8105N8      | SFP-SX               |
| Xcvr 4 | REV 01 | 740-011613 | PFM18EF      | SFP-SX               |
| Xcvr 7 | REV 01 | 740-011613 | PFF2AM8      | SFP-SX               |
| Xcvr 8 | REV 01 | 740-011613 | PFF2CT6      | SFP-SX               |
| PIC 1  |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) SFP     |
| Xcvr 0 | REV 01 | 740-011782 | PB82VHH      | SFP-SX               |
| Xcvr 1 | REV 01 | 740-011613 | PFF2CSW      | SFP-SX               |
| Xcvr 9 | REV 01 | 740-011613 | PFF2BY0      | SFP-SX               |
| QXM 0  | REV 04 | 711-028408 | JR6372       | MPC QXM              |
| FPC 8  | REV 05 | 750-024387 | JW9754       | MX FPC Type 2        |
| CPU    | REV 03 | 710-022351 | KF1651       | DPC PMB              |
| PIC 0  | REV 08 | 750-014730 | DM3664       | 4x OC-3 1x OC-12 SFP |
| Xcvr 0 | REV 01 | 740-016065 | 81S290N00077 | SFP-SR               |
| Xcvr 1 |        | NON-JNPR   | 2191844      | SFP-SR               |
| Xcvr 2 | REV 01 | 740-011618 | PD81EE5      | SFP-IR               |
| PIC 1  | REV 08 | 750-014637 | DM3671       | 4x OC-12-3 SFP       |
| Xcvr 0 | REV 01 | 740-011785 | PCK3UNK      | SFP-SR               |
| Xcvr 3 | REV 01 | 740-011785 | PDSOMPZ      | SFP-SR               |
| FPC 10 | REV 04 | 710-013699 | JY4654       | DPCE 40x 1GE R       |
| CPU    | REV 05 | 710-013713 | JS9717       | DPC PMB              |

|            |        |            |         |         |              |
|------------|--------|------------|---------|---------|--------------|
| PIC 0      |        |            | BUILTIN | BUILTIN | 10x 1GE(LAN) |
| Xcvr 5     | REV 01 | 740-011782 | PAR1L72 |         | SFP-SX       |
| Xcvr 6     | REV 01 | 740-011782 | P8N1YQ4 |         | SFP-SX       |
| PIC 1      |        |            | BUILTIN | BUILTIN | 10x 1GE(LAN) |
| PIC 2      |        |            | BUILTIN | BUILTIN | 10x 1GE(LAN) |
| Xcvr 0     | REV 01 | 740-011782 | P8Q2AVL |         | SFP-SX       |
| Xcvr 5     | REV 01 | 740-011782 | PAR1L7B |         | SFP-SX       |
| Xcvr 6     | REV 01 | 740-011782 | PAR1L2J |         | SFP-SX       |
| Xcvr 8     | REV 01 | 740-011782 | P8N1YMY |         | SFP-SX       |
| PIC 3      |        |            | BUILTIN | BUILTIN | 10x 1GE(LAN) |
| Fan Tray 0 | REV 03 | 740-014971 | TP0567  |         | Fan Tray     |
| Fan Tray 1 | REV 03 | 740-014971 | TP0702  |         | Fan Tray     |

### show chassis hardware models (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis hardware models
```

Hardware inventory:

| Item             | Version | Part number | Serial number | FRU model number       |
|------------------|---------|-------------|---------------|------------------------|
| Midplane         | REV 03  | 710-013698  | TR0183        | CHAS-BP-MX960-S        |
| Fan Extender     | REV 02  | 710-018051  | JY5227        | ECM-MX960              |
| FPM Board        | REV 03  | 710-014974  | JZ6876        | CRAFT-MX960-S          |
| Routing Engine 0 | REV 06  | 740-013063  | 1000687969    | RE-S-2000-4096-S       |
| Routing Engine 1 | REV 06  | 740-013063  | 1000687955    | RE-S-2000-4096-S       |
| CB 0             | REV 11  | 750-031391  | YZ6072        | SCBE-MX-S              |
| CB 1             | REV 11  | 750-031391  | YZ6068        | SCBE-MX-S              |
| CB 2             | REV 11  | 750-031391  | YZ6081        | SCBE-MX-S              |
| FPC 0            | REV 01  | 750-018122  | KA5576        | DPCE-R-40GE-SFP        |
| FPC 1            | REV 16  | 750-031089  | YL0719        | MX-MPC2-3D             |
| MIC 0            | REV 07  | 750-028387  | JR6500        | MIC-3D-4XGE-XFP        |
| MIC 1            | REV 24  | 750-028387  | YJ3950        | MIC-3D-4XGE-XFP        |
| FPC 2            | REV 08  | 710-014219  | JY9654        | DPC-R-4XGE-XFP         |
| FPC 3            | REV 10  | 750-024199  | XJ6692        | MX-FPC3                |
| PIC 0            | REV 17  | 750-009553  | RJ2945        | PC-40C48-SON-SFP       |
| PIC 1            | REV 32  | 750-003700  | DP2113        | PC-10C192-SON-VSR      |
| FPC 5            | REV 25  | 750-028467  | YM8256        | MPC-3D-16XGE-SFPP      |
| FPC 7            | REV 02  | 750-031092  | JR6658        | MX-MPC1-3D-Q           |
| MIC 0            | REV 08  | 750-028392  | JZ8737        | MIC-3D-20GE-SFP        |
| FPC 8            | REV 05  | 750-024387  | JW9754        | MX-FPC2                |
| PIC 0            | REV 08  | 750-014730  | DM3664        | PB-40C3-10C12-SON2-SFP |
| PIC 1            | REV 08  | 750-014637  | DM3671        | PB-40C3-40C12-SON-SFP  |
| FPC 10           | REV 04  | 710-013699  | JY4654        | DPC-R-40GE-SFP         |
| Fan Tray 0       | REV 03  | 740-014971  | TP0567        | FFANTRAY-MX960-S       |
| Fan Tray 1       | REV 03  | 740-014971  | TP0702        | FFANTRAY-MX960-S       |

### show chassis hardware (MX960 Router with MPC5EQ)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item             | Version | Part number | Serial number | Description               |
|------------------|---------|-------------|---------------|---------------------------|
| Chassis          |         |             | JN1214852AFA  | MX960                     |
| Midplane         | REV 01  | 710-030012  | ACAX3674      | MX960 Backplane           |
| FPM Board        | REV 03  | 710-014974  | CAAZ9326      | Front Panel Display       |
| PDM              | Rev 03  | 740-013110  | QCS17025017   | Power Distribution Module |
| PEM 0            | Rev 10  | 740-027760  | QCS1702N062   | PS 4.1kW; 200-240V AC     |
| PEM 1            | Rev 04  | 740-027760  | QCS1422N02C   | PS 4.1kW; 200-240V AC     |
| PEM 2            | Rev 09  | 740-027760  | QCS1614N01X   | PS 4.1kW; 200-240V AC     |
| Routing Engine 0 | REV 08  | 740-031116  | 9009131803    | RE-S-1800x4               |
| Routing Engine 1 | REV 08  | 740-031116  | 9009124913    | RE-S-1800x4               |

|        |        |            |           |                      |
|--------|--------|------------|-----------|----------------------|
| CB 0   | REV 18 | 750-031391 | CABF0579  | Enhanced MX SCB      |
| CB 1   | REV 16 | 750-031391 | CAAZ2471  | Enhanced MX SCB      |
| CB 2   | REV 16 | 750-031391 | CAAW9595  | Enhanced MX SCB      |
| FPC 0  | REV 18 | 750-046005 | CACE6574  | MPC5E 3D Q 2CGE+4XGE |
| CPU    | REV 09 | 711-045719 | CACG8908  | RMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQA0DYT   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0MS7   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 | REV 01 | 740-046563 | XD16FC03Z | CFP2-100G-SR10       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | ANA0NAJ   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0MRQ   | SFP+-10G-SR          |
| PIC 3  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 | REV 01 | 740-049775 | J13K72993 | CFP2-100G-LR4        |
| FPC 1  | REV 11 | 750-045372 | CABK8154  | MPCE Type 3 3D       |
| CPU    | REV 08 | 711-035209 | CABE7370  | HMPC PMB 2G          |
| MIC 0  | REV 07 | 750-033307 | CABD5255  | 10X10GE SFPP         |
| PIC 0  |        | BUILTIN    | BUILTIN   | 10X10GE SFPP         |
| Xcvr 0 | REV 01 | 740-021308 | AQ50319   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ5035V   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ502XJ   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ43HHR   | SFP+-10G-SR          |
| Xcvr 4 | REV 01 | 740-021308 | AQ502YA   | SFP+-10G-SR          |
| Xcvr 5 | REV 01 | 740-021308 | AQ502EU   | SFP+-10G-SR          |
| Xcvr 6 | REV 01 | 740-021308 | AQ502HR   | SFP+-10G-SR          |
| Xcvr 7 | REV 01 | 740-021308 | AQ502A6   | SFP+-10G-SR          |
| Xcvr 8 | REV 01 | 740-021308 | AQ43H8M   | SFP+-10G-SR          |
| MIC 1  | REV 14 | 750-033196 | CAAP1398  | 1X100GE CXP          |
| PIC 2  |        | BUILTIN    | BUILTIN   | 1X100GE CXP          |
| Xcvr 0 | REV 01 | 740-046563 | XD16FC064 | CFP-100G-SR10        |
| FPC 3  | REV 35 | 750-028467 | CAAT9156  | MPC 3D 16x 10GE      |
| CPU    | REV 11 | 711-029089 | CAAV4645  | AMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ43HZ1   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ43HZC   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ43HD2   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ502HN   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ43HGF   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ501RZ   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ5029V   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ501X9   | SFP+-10G-SR          |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ502ZN   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ43H86   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ502ZY   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ502PZ   | SFP+-10G-SR          |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ503E6   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ502XN   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-031980 | B11F00213 | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ50336   | SFP+-10G-SR          |
| FPC 4  | REV 18 | 750-046005 | CACE6568  | MPC5E 3D Q 2CGE+4XGE |
| CPU    | REV 09 | 711-045719 | CACG8900  | RMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQA095A   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0M1E   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 |        | NON-JNPR   | FE13F000F | CFP2-100G-SR10       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |

|          |             |            |           |                        |
|----------|-------------|------------|-----------|------------------------|
| Xcvr 0   | REV 01      | 740-021308 | AQGOLYC   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQGOLYB   | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN       |
| Xcvr 0   | REV 01      | 740-048813 | XD32FE00Z | CFP2-100G-SR10         |
| FPC 5    | REV 18      | 750-046005 | CACE6577  | MPC5E 3D Q 2CGE+4XGE   |
| CPU      | REV 09      | 711-045719 | CACG8902  | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN        |
| Xcvr 0   | REV 01      | 740-021308 | AQGOMXE   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQGOLVY   | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN       |
| Xcvr 0   | REV 01      | 740-046563 | XD16FC03T | CFP2-100G-SR10         |
| PIC 2    |             | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN        |
| Xcvr 0   | REV 01      | 740-021308 | AQGOLW1   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQGOLW3   | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN       |
| Xcvr 0   |             | NON-JNPR   | FE13F000J | CFP2-100G-SR10         |
| FPC 7    | REV 09      | 750-037355 | CAAF0937  | MPC4E 3D 2CGE+8XGE     |
| CPU      | REV 08      | 711-035209 | CAAD8004  | HMPD PMB 2G            |
| PIC 0    |             | BUILTIN    | BUILTIN   | 4x10GE SFPP            |
| Xcvr 0   | REV 01      | 740-021308 | ANAOMM3   | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN   | 1X100GE CFP            |
| Xcvr 0   | REV 01      | 740-035329 | X000C163  | CFP-100G-SR10          |
| PIC 2    |             | BUILTIN    | BUILTIN   | 4x10GE SFPP            |
| Xcvr 0   | REV 01      | 740-021308 | AQGOMS6   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQGOMRX   | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-021308 | AQGOM6Y   | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQGOLZM   | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN   | 1X100GE CFP            |
| Xcvr 0   | REV 01      | 740-035329 | X12J00499 | CFP-100G-SR10          |
| FPC 8    | REV 39      | 750-045715 | CACD1903  | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 09      | 711-045719 | CACD1815  | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN   | 12X10GE SFPP OTN       |
| PIC 1    |             | BUILTIN    | BUILTIN   | 12X10GE SFPP OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN   | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QC480289  | QSFPP+-40G-SR4         |
| Xcvr 1   | REV 01      | 740-046565 | QC480274  | QSFPP+-40G-SR4         |
| Xcvr 2   | REV 01      | 740-046565 | QD130190  | QSFPP+-40G-SR4         |
| PIC 3    |             | BUILTIN    | BUILTIN   | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QD130197  | QSFPP+-40G-SR4         |
| Xcvr 1   | REV 01      | 740-046565 | QD130180  | QSFPP+-40G-SR4         |
| Xcvr 2   | REV 01      | 740-046565 | QD130199  | QSFPP+-40G-SR4         |
| WAN MEZZ | REV 09      | 750-049136 | CABN0415  | MPC5E 24XGE OTN Mezz   |
| FPC 9    | REV 05      | 750-044444 | CAAY9801  | MPCE Type 2 3D P       |
| CPU      | REV 04      | 711-038484 | CAAW3673  | MPCE PMB 2G            |
| MIC 0    | REV 28      | 750-028387 | CAAX1071  | 3D 4x 10GE XFP         |
| PIC 0    |             | BUILTIN    | BUILTIN   | 2x 10GE XFP            |
| Xcvr 0   |             | NON-JNPR   | T12L92342 | XFP-10G-SR             |
| Xcvr 1   |             | NON-JNPR   | T12L92303 | XFP-10G-SR             |
| PIC 1    |             | BUILTIN    | BUILTIN   | 2x 10GE XFP            |
| Xcvr 0   |             | NON-JNPR   | CC07BK02X | XFP-10G-SR             |
| QXM 0    | REV 06      | 711-028408 | CAAW4883  | MPC QXM                |
| QXM 1    | REV 06      | 711-028408 | CAAW4603  | MPC QXM                |
| FPC 10   | REV 21.0.11 | 750-045715 | CAAY3541  | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 07      | 711-045719 | CAAW7426  | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN   | 12X10GE SFPP           |
| Xcvr 0   | REV 01      | 740-031980 | AHK01AP   | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQ502ZU   | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-031980 | AP41BLS   | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQA08YA   | SFP+-10G-SR            |
| Xcvr 4   | REV 01      | 740-021308 | AQA0K26   | SFP+-10G-SR            |
| Xcvr 6   | REV 01      | 740-021308 | AQA06S3   | SFP+-10G-SR            |

|            |        |            |              |                    |
|------------|--------|------------|--------------|--------------------|
| Xcvr 7     | REV 01 | 740-021308 | AQA06AS      | SFP+-10G-SR        |
| Xcvr 8     | REV 01 | 740-021308 | AQA053N      | SFP+-10G-SR        |
| Xcvr 9     | REV 01 | 740-021308 | AQA0E97      | SFP+-10G-SR        |
| Xcvr 10    | REV 01 | 740-021308 | AQA0GS4      | SFP+-10G-SR        |
| Xcvr 11    | REV 01 | 740-021308 | AQA0JVA      | SFP+-10G-SR        |
| PIC 1      |        | BUILTIN    | BUILTIN      | 12X10GE SFPP       |
| Xcvr 0     | REV 01 | 740-021308 | AQA057A      | SFP+-10G-SR        |
| Xcvr 1     | REV 01 | 740-021308 | ANA0MLS      | SFP+-10G-SR        |
| Xcvr 2     | REV 01 | 740-021308 | AQA093A      | SFP+-10G-SR        |
| Xcvr 3     | REV 01 | 740-021309 | 943153A00075 | SFP+-10G-LR        |
| Xcvr 4     | REV 01 | 740-021308 | AQA077B      | SFP+-10G-SR        |
| Xcvr 5     | REV 01 | 740-021308 | AQA0JSC      | SFP+-10G-SR        |
| Xcvr 6     | REV 01 | 740-021308 | AQA0735      | SFP+-10G-SR        |
| Xcvr 7     | REV 01 | 740-021308 | AQ5028N      | SFP+-10G-SR        |
| Xcvr 8     | REV 01 | 740-031980 | AP40VN5      | SFP+-10G-SR        |
| Xcvr 9     | REV 01 | 740-021308 | AQA0K0J      | SFP+-10G-SR        |
| Xcvr 10    | REV 01 | 740-021308 | AQA07AP      | SFP+-10G-SR        |
| Xcvr 11    | REV 01 | 740-021308 | AQA08YB      | SFP+-10G-SR        |
| PIC 2      |        | BUILTIN    | BUILTIN      | 3X40GE QSFPP       |
| PIC 3      |        | BUILTIN    | BUILTIN      | 3X40GE QSFPP       |
| WAN MEZZ   | REV 07 | 750-045717 | CAAX3123     | MPC5E 24XGE Mezz   |
| FPC 11     | REV 17 | 750-037355 | CAAT3986     | MPC4E 3D 2CGE+8XGE |
| CPU        | REV 08 | 711-035209 | CAAR3972     | HMPC PMB 2G        |
| PIC 0      |        | BUILTIN    | BUILTIN      | 4x10GE SFPP        |
| Xcvr 0     | REV 01 | 740-021308 | AQA0DSE      | SFP+-10G-SR        |
| Xcvr 1     | REV 01 | 740-021308 | AQ501Y3      | SFP+-10G-SR        |
| Xcvr 2     | REV 01 | 740-021308 | AQ501XU      | SFP+-10G-SR        |
| Xcvr 3     | REV 01 | 740-021308 | AQ5036Y      | SFP+-10G-SR        |
| PIC 1      |        | BUILTIN    | BUILTIN      | 1X100GE CFP        |
| Xcvr 0     |        | NON-JNPR   | X12J00247    | CFP-100G-SR10      |
| PIC 2      |        | BUILTIN    | BUILTIN      | 4x10GE SFPP        |
| Xcvr 0     | REV 01 | 740-031980 | ALQ1DKF      | SFP+-10G-SR        |
| Xcvr 1     | REV 01 | 740-031980 | AJ403YA      | SFP+-10G-SR        |
| Xcvr 2     | REV 01 | 740-031980 | AP40TY0      | SFP+-10G-SR        |
| Xcvr 3     | REV 01 | 740-031980 | ALQ14G0      | SFP+-10G-SR        |
| PIC 3      |        | BUILTIN    | BUILTIN      | 1X100GE CFP        |
| Xcvr 0     | REV 01 | 740-035329 | X12J00095    | CFP-100G-SR10      |
| Fan Tray 0 | REV 08 | 740-031521 | ACAF4219     | Enhanced Fan Tray  |
| Fan Tray 1 | REV 08 | 740-031521 | ACAF4225     | Enhanced Fan Tray  |

### show chassis hardware detail (MX960 Router)

```
user@host> show chassis hardware detail
```

| Hardware inventory: |          |                   |                  |                         |
|---------------------|----------|-------------------|------------------|-------------------------|
| Item                | Version  | Part number       | Serial number    | Description             |
| Chassis             |          |                   |                  | MX960                   |
| Midplane            | REV 01   | 710-013698        | AA6082           | MX960 Midplane          |
| PIM                 | Rev 01   | 740-013110        | 000008           | Power Inlet Module      |
| PEM 2               |          |                   |                  |                         |
| PEM 3               | Rev 01   | 740-013682        | 000038           | PS 1.7kW; 200-240VAC in |
| Routing Engine 0    | REV 00   | 740-015113        | 1000617944       | RE-S-1300               |
| ad0                 | 245 MB   | SanDisk SDCFB-256 | 111419E1805T1141 | Compact Flash           |
| ad2                 | 38154 MB | FUJITSU MHT2040BH | NROWT5925N77     | Hard Disk               |
| CB 0                | REV 05   | 710-013725        | JK6947           | MX960 Test SCB          |
| FPC 4               | REV 01   | 710-013305        | JM7617           | MX960 Test DPC          |
| CPU                 |          |                   |                  |                         |
| PIC 0               |          | BUILTIN           | BUILTIN          | 1x 10GE(LAN/WAN)        |
| PIC 1               |          | BUILTIN           | BUILTIN          | 10x 1GE                 |
| FPC 7               | REV 01   | 710-013305        | JL9634           | MX960 Test DPC          |
| CPU                 |          |                   |                  |                         |
| PIC 0               |          | BUILTIN           | BUILTIN          | 1x 10GE(LAN/WAN)        |

|            |        |            |            |            |
|------------|--------|------------|------------|------------|
| Xcvr 0     |        | NON-JNPR   | MYBG65I82C | XFP-10G-SR |
| PIC 1      |        | BUILTIN    | BUILTIN    | 10x 1GE    |
| Xcvr 1     | REV 01 | 740-011782 | P7N0368    | SFP-SX     |
| Xcvr 4     | REV 01 | 740-011782 | P8J1W27    | SFP-SX     |
| Xcvr 6     | REV 01 | 740-011782 | P8J1VSD    | SFP-SX     |
| Xcvr 9     | REV 01 | 740-011782 | P8J1W25    | SFP-SX     |
| Fan Tray 0 |        |            |            |            |
| Fan Tray 1 |        |            |            |            |

### show chassis hardware detail (MX960 Router with MPC5EQ)

```
user@host> show chassis hardware detail
```

```
Hardware inventory:
```

| Item             | Version             | Part number     | Serial number      | Description               |
|------------------|---------------------|-----------------|--------------------|---------------------------|
| Chassis          |                     |                 | JN1214852AFA       | MX960                     |
| Midplane         | REV 01              | 710-030012      | ACAX3674           | MX960 Backplane           |
| FPM Board        | REV 03              | 710-014974      | CAAZ9326           | Front Panel Display       |
| PDM              | Rev 03              | 740-013110      | QCS17025017        | Power Distribution Module |
| PEM 0            | Rev 10              | 740-027760      | QCS1702N062        | PS 4.1kW; 200-240V AC     |
| in               |                     |                 |                    |                           |
| PEM 1            | Rev 04              | 740-027760      | QCS1422N02C        | PS 4.1kW; 200-240V AC     |
| in               |                     |                 |                    |                           |
| PEM 2            | Rev 09              | 740-027760      | QCS1614N01X        | PS 4.1kW; 200-240V AC     |
| in               |                     |                 |                    |                           |
| Routing Engine 0 | REV 08              | 740-031116      | 9009131803         | RE-S-1800x4               |
| ad0 3831 MB      | UGB30SFA4000T1      |                 | SFA4000T1 000016CD | Compact Flash             |
| ad1 30533 MB     | UGB94BPH32H0S1-KCI  |                 | 11000061346        | Disk 1                    |
| usb0 (addr 1)    | EHCI root hub 0     |                 | Intel              | uhub0                     |
| usb0 (addr 2)    | product 0x0020 32   |                 | vendor 0x8087      | uhub1                     |
| DIMM 0           | VL31B5263F-F8SD DIE | REV-0 PCB REV-0 |                    | MFR ID-ce80               |
| DIMM 1           | VL31B5263F-F8SD DIE | REV-0 PCB REV-0 |                    | MFR ID-ce80               |
| DIMM 2           | VL31B5263F-F8SD DIE | REV-0 PCB REV-0 |                    | MFR ID-ce80               |
| DIMM 3           | VL31B5263F-F8SD DIE | REV-0 PCB REV-0 |                    | MFR ID-ce80               |
| Routing Engine 1 | REV 08              | 740-031116      | 9009124913         | RE-S-1800x4               |
| ad0 3831 MB      | UGB30SFA4000T1      |                 | SFA4000T1 0000106D | Compact Flash             |
| ad1 30533 MB     | UGB94BPH32H0S1-KCI  |                 | 11000052402        | Disk 1                    |
| CB 0             | REV 18              | 750-031391      | CABF0579           | Enhanced MX SCB           |
| CB 1             | REV 16              | 750-031391      | CAAZ2471           | Enhanced MX SCB           |
| CB 2             | REV 16              | 750-031391      | CAAW9595           | Enhanced MX SCB           |
| FPC 0            | REV 18              | 750-046005      | CACE6574           | MPC5E 3D Q 2CGE+4XGE      |
| CPU              | REV 09              | 711-045719      | CACG8908           | RMPC PMB                  |
| PIC 0            |                     | BUILTIN         | BUILTIN            | 2X10GE SFPP OTN           |
| Xcvr 0           | REV 01              | 740-021308      | AQA0DYT            | SFP+-10G-SR               |
| Xcvr 1           | REV 01              | 740-021308      | AQGOMS7            | SFP+-10G-SR               |
| PIC 1            |                     | BUILTIN         | BUILTIN            | 1X100GE CFP2 OTN          |
| Xcvr 0           | REV 01              | 740-046563      | XD16FC03Z          | CFP2-100G-SR10            |
| PIC 2            |                     | BUILTIN         | BUILTIN            | 2X10GE SFPP OTN           |
| Xcvr 0           | REV 01              | 740-021308      | ANA0NAJ            | SFP+-10G-SR               |
| Xcvr 1           | REV 01              | 740-021308      | AQGOMRQ            | SFP+-10G-SR               |
| PIC 3            |                     | BUILTIN         | BUILTIN            | 1X100GE CFP2 OTN          |
| Xcvr 0           | REV 01              | 740-049775      | J13K72993          | CFP2-100G-LR4             |
| FPC 1            | REV 11              | 750-045372      | CABK8154           | MPCE Type 3 3D            |
| CPU              | REV 08              | 711-035209      | CABE7370           | HMPC PMB 2G               |
| MIC 0            | REV 07              | 750-033307      | CABD5255           | 10X10GE SFPP              |
| PIC 0            |                     | BUILTIN         | BUILTIN            | 10X10GE SFPP              |
| Xcvr 0           | REV 01              | 740-021308      | AQ50319            | SFP+-10G-SR               |
| Xcvr 1           | REV 01              | 740-021308      | AQ5035V            | SFP+-10G-SR               |
| Xcvr 2           | REV 01              | 740-021308      | AQ502XJ            | SFP+-10G-SR               |
| Xcvr 3           | REV 01              | 740-021308      | AQ43HHR            | SFP+-10G-SR               |
| Xcvr 4           | REV 01              | 740-021308      | AQ502YA            | SFP+-10G-SR               |
| Xcvr 5           | REV 01              | 740-021308      | AQ502EU            | SFP+-10G-SR               |



|        |        |            |           |                      |
|--------|--------|------------|-----------|----------------------|
| Xcvr 6 | REV 01 | 740-021308 | AQ502HR   | SFP+-10G-SR          |
| Xcvr 7 | REV 01 | 740-021308 | AQ502A6   | SFP+-10G-SR          |
| Xcvr 8 | REV 01 | 740-021308 | AQ43H8M   | SFP+-10G-SR          |
| MIC 1  | REV 14 | 750-033196 | CAAP1398  | 1X100GE CXP          |
| PIC 2  |        | BUILTIN    | BUILTIN   | 1X100GE CXP          |
| Xcvr 0 | REV 01 | 740-046563 | XD16FC064 | CFP2-100G-SR10       |
| FPC 3  | REV 35 | 750-028467 | CAAT9156  | MPC 3D 16x 10GE      |
| CPU    | REV 11 | 711-029089 | CAAV4645  | AMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ43HZ1   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ43HZC   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ43HD2   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ502HN   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ43HGF   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ501RZ   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ5029V   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ501X9   | SFP+-10G-SR          |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ502ZN   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ43H86   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-021308 | AQ502ZY   | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ502PZ   | SFP+-10G-SR          |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+    |
| Xcvr 0 | REV 01 | 740-021308 | AQ503E6   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQ502XN   | SFP+-10G-SR          |
| Xcvr 2 | REV 01 | 740-031980 | B11F00213 | SFP+-10G-SR          |
| Xcvr 3 | REV 01 | 740-021308 | AQ50336   | SFP+-10G-SR          |
| FPC 4  | REV 18 | 750-046005 | CACE6568  | MPC5E 3D Q 2CGE+4XGE |
| CPU    | REV 09 | 711-045719 | CACG8900  | RMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQA095A   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0M1E   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 |        | NON-JNPR   | FE13F000F | CFP2-100G-SR10       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQG0LYC   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0LYB   | SFP+-10G-SR          |
| PIC 3  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 | REV 01 | 740-048813 | XD32FE00Z | CFP2-100G-SR10       |
| FPC 5  | REV 18 | 750-046005 | CACE6577  | MPC5E 3D Q 2CGE+4XGE |
| CPU    | REV 09 | 711-045719 | CACG8902  | RMPC PMB             |
| PIC 0  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQG0MXE   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0LVY   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 | REV 01 | 740-046563 | XD16FC03T | CFP2-100G-SR10       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 2X10GE SFPP OTN      |
| Xcvr 0 | REV 01 | 740-021308 | AQG0LW1   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0LW3   | SFP+-10G-SR          |
| PIC 3  |        | BUILTIN    | BUILTIN   | 1X100GE CFP2 OTN     |
| Xcvr 0 |        | NON-JNPR   | FE13F000J | CFP2-100G-SR10       |
| FPC 7  | REV 09 | 750-037355 | CAAF0937  | MPC4E 3D 2CGE+8XGE   |
| CPU    | REV 08 | 711-035209 | CAAD8004  | HMPC PMB 2G          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x10GE SFPP          |
| Xcvr 0 | REV 01 | 740-021308 | ANA0MM3   | SFP+-10G-SR          |
| PIC 1  |        | BUILTIN    | BUILTIN   | 1X100GE CFP          |
| Xcvr 0 | REV 01 | 740-035329 | X000C163  | CFP-100G-SR10        |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x10GE SFPP          |
| Xcvr 0 | REV 01 | 740-021308 | AQG0MS6   | SFP+-10G-SR          |
| Xcvr 1 | REV 01 | 740-021308 | AQG0MRX   | SFP+-10G-SR          |

|          |             |            |              |                        |
|----------|-------------|------------|--------------|------------------------|
| Xcvr 2   | REV 01      | 740-021308 | AQG0M6Y      | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQG0LZM      | SFP+-10G-SR            |
| PIC 3    |             | BUILTIN    | BUILTIN      | 1X100GE CFP            |
| Xcvr 0   | REV 01      | 740-035329 | X12J00499    | CFP-100G-SR10          |
| FPC 8    | REV 39      | 750-045715 | CACD1903     | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 09      | 711-045719 | CACD1815     | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| PIC 1    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QC480289     | QSFP+-40G-SR4          |
| Xcvr 1   | REV 01      | 740-046565 | QC480274     | QSFP+-40G-SR4          |
| Xcvr 2   | REV 01      | 740-046565 | QD130190     | QSFP+-40G-SR4          |
| PIC 3    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QD130197     | QSFP+-40G-SR4          |
| Xcvr 1   | REV 01      | 740-046565 | QD130180     | QSFP+-40G-SR4          |
| Xcvr 2   | REV 01      | 740-046565 | QD130199     | QSFP+-40G-SR4          |
| WAN MEZZ | REV 09      | 750-049136 | CABN0415     | MPC5E 24XGE OTN Mezz   |
| FPC 9    | REV 05      | 750-044444 | CAAY9801     | MPCE Type 2 3D P       |
| CPU      | REV 04      | 711-038484 | CAAW3673     | MPCE PMB 2G            |
| MIC 0    | REV 28      | 750-028387 | CAAX1071     | 3D 4x 10GE XFP         |
| PIC 0    |             | BUILTIN    | BUILTIN      | 2x 10GE XFP            |
| Xcvr 0   |             | NON-JNPR   | T12L92342    | XFP-10G-SR             |
| Xcvr 1   |             | NON-JNPR   | T12L92303    | XFP-10G-SR             |
| PIC 1    |             | BUILTIN    | BUILTIN      | 2x 10GE XFP            |
| Xcvr 0   |             | NON-JNPR   | CC07BK02X    | XFP-10G-SR             |
| QXM 0    | REV 06      | 711-028408 | CAAW4883     | MPC QXM                |
| QXM 1    | REV 06      | 711-028408 | CAAW4603     | MPC QXM                |
| FPC 10   | REV 21.0.11 | 750-045715 | CAAY3541     | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 07      | 711-045719 | CAAW7426     | RMPD PMB               |
| PIC 0    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP           |
| Xcvr 0   | REV 01      | 740-031980 | AHK01AP      | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQ502ZU      | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-031980 | AP41BLS      | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQA08YA      | SFP+-10G-SR            |
| Xcvr 4   | REV 01      | 740-021308 | AQA0K26      | SFP+-10G-SR            |
| Xcvr 6   | REV 01      | 740-021308 | AQA06S3      | SFP+-10G-SR            |
| Xcvr 7   | REV 01      | 740-021308 | AQA06AS      | SFP+-10G-SR            |
| Xcvr 8   | REV 01      | 740-021308 | AQA053N      | SFP+-10G-SR            |
| Xcvr 9   | REV 01      | 740-021308 | AQA0E97      | SFP+-10G-SR            |
| Xcvr 10  | REV 01      | 740-021308 | AQA0GS4      | SFP+-10G-SR            |
| Xcvr 11  | REV 01      | 740-021308 | AQA0JVA      | SFP+-10G-SR            |
| PIC 1    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP           |
| Xcvr 0   | REV 01      | 740-021308 | AQA057A      | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | ANA0MLS      | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-021308 | AQA093A      | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021309 | 943153A00075 | SFP+-10G-LR            |
| Xcvr 4   | REV 01      | 740-021308 | AQA077B      | SFP+-10G-SR            |
| Xcvr 5   | REV 01      | 740-021308 | AQA0JSC      | SFP+-10G-SR            |
| Xcvr 6   | REV 01      | 740-021308 | AQA0735      | SFP+-10G-SR            |
| Xcvr 7   | REV 01      | 740-021308 | AQ5028N      | SFP+-10G-SR            |
| Xcvr 8   | REV 01      | 740-031980 | AP40VN5      | SFP+-10G-SR            |
| Xcvr 9   | REV 01      | 740-021308 | AQA0K0J      | SFP+-10G-SR            |
| Xcvr 10  | REV 01      | 740-021308 | AQA07AP      | SFP+-10G-SR            |
| Xcvr 11  | REV 01      | 740-021308 | AQA08YB      | SFP+-10G-SR            |
| PIC 2    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| PIC 3    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| WAN MEZZ | REV 07      | 750-045717 | CAAX3123     | MPC5E 24XGE Mezz       |
| FPC 11   | REV 17      | 750-037355 | CAAT3986     | MPC4E 3D 2CGE+8XGE     |
| CPU      | REV 08      | 711-035209 | CAAR3972     | HMPC PMB 2G            |
| PIC 0    |             | BUILTIN    | BUILTIN      | 4x10GE SFPP            |
| Xcvr 0   | REV 01      | 740-021308 | AQA0DSE      | SFP+-10G-SR            |

|            |        |            |           |                   |
|------------|--------|------------|-----------|-------------------|
| Xcvr 1     | REV 01 | 740-021308 | AQ501Y3   | SFP+-10G-SR       |
| Xcvr 2     | REV 01 | 740-021308 | AQ501XU   | SFP+-10G-SR       |
| Xcvr 3     | REV 01 | 740-021308 | AQ5036Y   | SFP+-10G-SR       |
| PIC 1      |        | BUILTIN    | BUILTIN   | 1X100GE CFP       |
| Xcvr 0     |        | NON-JNPR   | X12J00247 | CFP-100G-SR10     |
| PIC 2      |        | BUILTIN    | BUILTIN   | 4x10GE SFPP       |
| Xcvr 0     | REV 01 | 740-031980 | ALQ1DKF   | SFP+-10G-SR       |
| Xcvr 1     | REV 01 | 740-031980 | AJ403YA   | SFP+-10G-SR       |
| Xcvr 2     | REV 01 | 740-031980 | AP40TY0   | SFP+-10G-SR       |
| Xcvr 3     | REV 01 | 740-031980 | ALQ14G0   | SFP+-10G-SR       |
| PIC 3      |        | BUILTIN    | BUILTIN   | 1X100GE CFP       |
| Xcvr 0     | REV 01 | 740-035329 | X12J00095 | CFP-100G-SR10     |
| Fan Tray 0 | REV 08 | 740-031521 | ACAF4219  | Enhanced Fan Tray |
| Fan Tray 1 | REV 08 | 740-031521 | ACAF4225  | Enhanced Fan Tray |

### show chassis hardware extensive (MX960 Router with MPC5EQ)

```

user@host> show chassis hardware extensive
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Jedec Code:   0x7fb0          EEPROM Version: 0x02
S/N:          JN1214852AFA
Assembly ID:  0x0512          Assembly Version: 00.00
Date:         00-00-0000      Assembly Flags:  0x00
ID: MX960
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 05 12 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: 4a 4e 31 32 31 34 38 35 32 41 46 41 00 00 00 00
Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane      REV 01  710-030012  ACAX3674      MX960 Backplane
Jedec Code:   0x7fb0          EEPROM Version: 0x02
P/N:          710-030012      S/N:          ACAX3674
Assembly ID:  0x01df          Assembly Version: 01.01
Date:         01-19-2013      Assembly Flags: 0x00
Version:      REV 01          CLEI Code:    COM8T00CRB
ID: MX960 Backplane          FRU Model Number: CHAS-BP-MX960-S
Board Information Record:
Address 0x00: ad 01 08 00 54 e0 32 bc 68 00 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 01 df 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 33 30 30 31 32 00 00
Address 0x20: 53 2f 4e 20 41 43 41 58 33 36 37 34 00 13 01 07
Address 0x30: dd ff ff ff ad 01 08 00 54 e0 32 bc 68 00 ff ff
Address 0x40: ff ff ff ff 01 43 4f 4d 38 54 30 30 43 52 42 43
Address 0x50: 48 41 53 2d 42 50 2d 4d 58 39 36 30 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 42 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff aa ff ff ff ff ff ff ff ff ff ff ff ff
FPM Board     REV 03  710-014974  CAAZ9326      Front Panel Display
Jedec Code:   0x7fb0          EEPROM Version: 0x01
P/N:          710-014974      S/N:          CAAZ9326
Assembly ID:  0x01e6          Assembly Version: 01.03
Date:         12-31-2012      Assembly Flags: 0x00
Version:      REV 03

```

```

ID: Front Panel Display          FRU Model Number: CRAFT-MX960-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 01 e6 01 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 31 30 2d 30 31 34 39 37 34 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 5a 39 33 32 36 00 1f 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 43
  Address 0x50: 52 41 46 54 2d 4d 58 39 36 30 2d 53 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
PDM                               Rev 03   740-013110   QCS17025017   Power Distribution Module
Jedec Code: 0x7fb0                EEPROM Version: 0x01
P/N: 740-013110                  S/N: QCS17025017
Assembly ID: 0x0416              Assembly Version: 01.03
Date: 01-10-2013                 Assembly Flags: 0x00
Version: Rev 03
ID: Power Distribution Module
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 16 01 03 52 65 76 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 31 33 31 31 30 00 00
  Address 0x20: 51 43 53 31 37 30 32 35 30 31 37 00 00 0a 01 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
PEM 0                             Rev 10   740-027760   QCS1702N062   PS 4.1kW; 200-240V AC
in
Jedec Code: 0x7fb0                EEPROM Version: 0x01
P/N: 740-027760                  S/N: QCS1702N062
Assembly ID: 0x0430              Assembly Version: 01.10
Date: 01-15-2013                 Assembly Flags: 0x00
Version: Rev 10
ID: PS 4.1kW; 200-240V AC in     FRU Model Number: PWR-MX960-4100-AC-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 30 01 0a 52 65 76 20 31 30 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 32 37 37 36 30 00 00
  Address 0x20: 51 43 53 31 37 30 32 4e 30 36 32 00 00 0f 01 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
  Address 0x50: 57 52 2d 4d 58 39 36 30 2d 34 31 30 30 2d 41 43
  Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
PEM 1                             Rev 04   740-027760   QCS1422N02C   PS 4.1kW; 200-240V AC
in
Jedec Code: 0x7fb0                EEPROM Version: 0x01
P/N: 740-027760                  S/N: QCS1422N02C
Assembly ID: 0x0430              Assembly Version: 01.04
Date: 06-04-2010                 Assembly Flags: 0x00
Version: Rev 04
ID: PS 4.1kW; 200-240V AC in     FRU Model Number: PWR-MX960-4100-AC-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 30 01 04 52 65 76 20 30 34 00 00

```

```

Address 0x10: 00 00 00 00 37 34 30 2d 30 32 37 37 36 30 00 00
Address 0x20: 51 43 53 31 34 32 32 4e 30 32 43 00 00 04 06 07
Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
Address 0x50: 57 52 2d 4d 58 39 36 30 2d 34 31 30 30 2d 41 43
Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
PEM 2          Rev 09    740-027760    QCS1614N01X    PS 4.1kW; 200-240V AC
in
Jedec Code:    0x7fb0          EEPROM Version:    0x01
P/N:           740-027760      S/N:              QCS1614N01X
Assembly ID:   0x0430          Assembly Version:  01.09
Date:          04-07-2012      Assembly Flags:    0x00
Version:       Rev 09
ID: PS 4.1kW; 200-240V AC in    FRU Model Number: PWR-MX960-4100-AC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 30 01 09 52 65 76 20 30 39 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 32 37 37 36 30 00 00
Address 0x20: 51 43 53 31 36 31 34 4e 30 31 58 00 00 07 04 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 00 00 00 00 01 00 00 00 00 00 00 00 00 00 00 50
Address 0x50: 57 52 2d 4d 58 39 36 30 2d 34 31 30 30 2d 41 43
Address 0x60: 2d 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Routing Engine 0 REV 08    740-031116    9009131803    RE-S-1800x4
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:           740-031116      S/N:              9009131803
Assembly ID:   0x09c0          Assembly Version:  01.08
Date:          03-04-2013      Assembly Flags:    0x00
Version:       REV 08          CLEI Code:        COUCASKBAA
ID: RE-S-1800x4          FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:
Address 0x00: 54 32 30 32 37 44 42 2d 34 34 47 42 23 42 23 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 31 31 31 36 00 00
Address 0x20: 39 30 30 39 31 33 31 38 30 33 00 00 00 04 03 07
Address 0x30: dd ff ff ff 54 32 30 32 37 44 42 2d 34 34 47 42
Address 0x40: 23 42 23 00 01 43 4f 55 43 41 53 4b 42 41 41 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 59 ff ff ff ff ff ff ff ff ff ff ff ff ff
ad0    3831 MB    UGB30SFA4000T1    SFA4000T1 000016CD Compact Flash
ad1    30533 MB   UGB94BPH32H0S1-KCI    11000061346    Disk 1
usb0 (addr 1) EHCI root hub 0    Intel    uhub0
usb0 (addr 2) product 0x0020 32    vendor 0x8087    uhub1
DIMM 0    VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
DIMM 1    VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
DIMM 2    VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
DIMM 3    VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
Routing Engine 1 REV 08    740-031116    9009124913    RE-S-1800x4
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:           740-031116      S/N:              9009124913
Assembly ID:   0x09c0          Assembly Version:  01.08
Date:          01-09-2013      Assembly Flags:    0x00
Version:       REV 08          CLEI Code:        COUCASKBAA
ID: RE-S-1800x4          FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:
Address 0x00: 54 32 30 32 37 44 42 2d 34 34 47 42 23 42 23 00

```

```

I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 31 31 31 36 00 00
Address 0x20: 39 30 30 39 31 32 34 39 31 33 00 00 00 09 01 07
Address 0x30: dd ff ff ff 54 32 30 32 37 44 42 2d 34 34 47 42
Address 0x40: 23 42 23 00 01 43 4f 55 43 41 53 4b 42 41 41 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 59 ff ff ff ff ff ff ff ff ff ff ff
ad0 3831 MB UGB30SFA4000T1 SFA4000T1 0000106D Compact Flash
ad1 30533 MB UGB94BPH32H0S1-KCI 11000052402 Disk 1
CB 0 REV 18 750-031391 CABF0579 Enhanced MX SCB
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-031391 S/N: CABF0579
Assembly ID: 0x09b0 Assembly Version: 01.18
Date: 04-15-2013 Assembly Flags: 0x00
Version: REV 18 CLEI Code: COUCASRBAA
ID: Enhanced MX SCB FRU Model Number: SCBE-MX-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 b0 01 12 52 45 56 20 31 38 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 31 33 39 31 00 00
Address 0x20: 53 2f 4e 20 43 41 42 46 30 35 37 39 00 0f 04 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4f 55 43 41 53 52 42 41 41 53
Address 0x50: 43 42 45 2d 4d 58 2d 53 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 43 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 7d ff ff ff ff ff ff ff ff ff ff ff ff
CB 1 REV 16 750-031391 CAAZ2471 Enhanced MX SCB
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-031391 S/N: CAAZ2471
Assembly ID: 0x09b0 Assembly Version: 01.16
Date: 03-09-2013 Assembly Flags: 0x00
Version: REV 16 CLEI Code: COUCARCBAB
ID: Enhanced MX SCB FRU Model Number: SCBE-MX-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 b0 01 10 52 45 56 20 31 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 31 33 39 31 00 00
Address 0x20: 53 2f 4e 20 43 41 41 5a 32 34 37 31 00 09 03 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4f 55 43 41 52 43 42 41 42 53
Address 0x50: 43 42 45 2d 4d 58 2d 53 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 42 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 6d ff ff ff ff ff ff ff ff ff ff ff ff
CB 2 REV 16 750-031391 CAAW9595 Enhanced MX SCB
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-031391 S/N: CAAW9595
Assembly ID: 0x09b0 Assembly Version: 01.16
Date: 02-01-2013 Assembly Flags: 0x00
Version: REV 16 CLEI Code: COUCARCBAB
ID: Enhanced MX SCB FRU Model Number: SCBE-MX-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 b0 01 10 52 45 56 20 31 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 31 33 39 31 00 00
Address 0x20: 53 2f 4e 20 43 41 41 57 39 35 39 35 00 01 02 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

```

```

Address 0x40: ff ff ff ff 01 43 4f 55 43 41 52 43 42 41 42 53
Address 0x50: 43 42 45 2d 4d 58 2d 53 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 42 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 6d ff ff ff ff ff ff ff ff ff ff ff ff
FPC 0          REV 18    750-046005    CACE6574          MPC5E 3D Q 2CGE+4XGE
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          750-046005          S/N:          CACE6574
Assembly ID:   0x0b8c          Assembly Version: 01.18
Date:          11-20-2013        Assembly Flags:  0x00
Version:       REV 18          CLEI Code:      PROTOXCLEI
ID: MPC5E 3D Q 2CGE+4XGE        FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 8c 01 12 52 45 56 20 31 38 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 36 30 30 35 00 00
Address 0x20: 53 2f 4e 20 43 41 43 45 36 35 37 34 00 14 0b 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
CPU          REV 09    711-045719    CACG8908          RMPC PMB
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          711-045719          S/N:          CACG8908
Assembly ID:   0x0b85          Assembly Version: 01.09
Date:          11-13-2013        Assembly Flags:  0x00
Version:       REV 09
ID: RMPC PMB
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 85 01 09 52 45 56 20 30 39 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 34 35 37 31 39 00 00
Address 0x20: 53 2f 4e 20 43 41 43 47 38 39 30 38 00 0d 0b 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff c2 00 00 00 00 00 00 00 00 00 00 00 00
PIC 0          BUILTIN    BUILTIN          2X10GE SFPP OTN
Jedec Code:    0x0000          EEPROM Version:    0x00
P/N:          BUILTIN          S/N:          BUILTIN
Assembly ID:   0x0a90          Assembly Version: 00.00
Date:          00-00-0000        Assembly Flags:  0x00
ID: 2X10GE SFPP OTN
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 90 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 ae dc 00 00 00 00 0a 6e 00 00
Xcvr 0          REV 01    740-021308    AQA0DYT          SFP+-10G-SR
Xcvr 1          REV 01    740-021308    AQG0MS7          SFP+-10G-SR
PIC 1          BUILTIN    BUILTIN          1X100GE CFP2 OTN
Jedec Code:    0x0000          EEPROM Version:    0x00

```

```

P/N:          BUILTIN          S/N:          BUILTIN
Assembly ID:  0x0a6e          Assembly Version: 00.00
Date:         00-00-0000      Assembly Flags:  0x00
ID: 1X100GE CFP2 OTN
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 6e 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 03 f3 8c 31 5c e7 80 00 00 00 02
Xcvr 0      REV 01  740-046563  XD16FC03Z      CFP2-100G-SR10
PIC 2      BUILTIN  BUILTIN      2X10GE SFPP OTN
Jedec Code: 0x0000          EEPROM Version: 0x00
P/N:        BUILTIN          S/N:        BUILTIN
Assembly ID: 0x0a90          Assembly Version: 00.00
Date:       00-00-0000      Assembly Flags:  0x00
ID: 2X10GE SFPP OTN
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 90 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 03 f5 6c 31 5c db 40 00 00 00 02
Xcvr 0      REV 01  740-021308  ANAONAJ      SFP+-10G-SR
Xcvr 1      REV 01  740-021308  AQGOMRQ      SFP+-10G-SR
PIC 3      BUILTIN  BUILTIN      1X100GE CFP2 OTN
Jedec Code: 0x0000          EEPROM Version: 0x00
P/N:        BUILTIN          S/N:        BUILTIN
Assembly ID: 0x0a6e          Assembly Version: 00.00
Date:       00-00-0000      Assembly Flags:  0x00
ID: 1X100GE CFP2 OTN
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 6e 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 03 ed ec 31 5c e2 e8 00 00 00 02
Xcvr 0      REV 01  740-049775  J13K72993    CFP2-100G-LR4
FPC 1      REV 11  750-045372  CABK8154      MPCE Type 3 3D
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N:        750-045372      S/N:        CABK8154
Assembly ID: 0x09db          Assembly Version: 04.11
Date:       05-18-2013      Assembly Flags:  0x00
Version:    REV 11          CLEI Code:    COUIBBNBA
ID: MPCE Type 3 3D          FRU Model Number: MX-MPC3E-3D
Board Information Record:

```



```

Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 db 04 0b 52 45 56 20 31 31 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 35 33 37 32 00 00
Address 0x20: 53 2f 4e 20 43 41 42 4b 38 31 35 34 00 12 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4f 55 49 42 42 4e 42 41 41 4d
Address 0x50: 58 2d 4d 50 43 33 45 2d 33 44 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 44 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff cf ff ff ff ff ff ff ff ff ff ff ff ff
CPU          REV 08    711-035209    CABE7370          HMPC PMB 2G
Jedec Code:  0x7fb0          EEPROM Version:  0x01
P/N:         711-035209          S/N:          CABE7370
Assembly ID: 0x0b04          Assembly Version: 01.08
Date:        05-08-2013          Assembly Flags: 0x00
Version:     REV 08
ID: HMPC PMB 2G
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 0b 04 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 35 32 30 39 00 00
Address 0x20: 53 2f 4e 20 43 41 42 45 37 33 37 30 00 08 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
MIC 0          REV 07    750-033307    CABD5255          10X10GE SFPP
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         750-033307          S/N:          CABD5255
Assembly ID: 0x0a2a          Assembly Version: 02.07
Date:        04-25-2013          Assembly Flags: 0x00
Version:     REV 07          CLEI Code:     COUIBBJBAA
ID: 10X10GE SFPP          FRU Model Number: MIC3-3D-10XGE-SFPP
Board Information Record:
Address 0x00: 34 01 03 03 05 ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 fe 0a 2a 02 07 52 45 56 20 30 37 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 33 33 30 37 00 00
Address 0x20: 53 2f 4e 20 43 41 42 44 35 32 35 35 00 19 04 07
Address 0x30: dd ff ff ff 34 01 03 03 05 ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4f 55 49 42 42 4a 42 41 41 4d
Address 0x50: 49 43 33 2d 33 44 2d 31 30 58 47 45 2d 53 46 50
Address 0x60: 50 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 82 c0 03 f0 bc 57 79 83 80 00 00 00 02
PIC 0          BUILTIN    BUILTIN          10X10GE SFPP
Xcvr 0          REV 01    740-021308    AQ50319          SFP+-10G-SR
Xcvr 1          REV 01    740-021308    AQ5035V          SFP+-10G-SR
Xcvr 2          REV 01    740-021308    AQ502XJ          SFP+-10G-SR
Xcvr 3          REV 01    740-021308    AQ43HHR          SFP+-10G-SR
Xcvr 4          REV 01    740-021308    AQ502YA          SFP+-10G-SR
Xcvr 5          REV 01    740-021308    AQ502EU          SFP+-10G-SR
Xcvr 6          REV 01    740-021308    AQ502HR          SFP+-10G-SR
Xcvr 7          REV 01    740-021308    AQ502A6          SFP+-10G-SR
Xcvr 8          REV 01    740-021308    AQ43H8M          SFP+-10G-SR
MIC 1          REV 14    750-033196    CAAP1398          1X100GE CXP
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         750-033196          S/N:          CAAP1398
Assembly ID: 0x0a29          Assembly Version: 03.14
Date:        10-27-2012          Assembly Flags: 0x00

```

```

Version:      REV 14          CLEI Code:      COUIBBKBAA
ID: 1X100GE CXP          FRU Model Number: MIC3-3D-1X100GE-CXP
Board Information Record:
  Address 0x00: 34 01 07 07 08 ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 fe 0a 29 03 0e 52 45 56 20 31 34 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 33 31 39 36 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 50 31 33 39 38 00 1b 0a 07
  Address 0x30: dc ff ff ff 34 01 07 07 08 ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4f 55 49 42 42 4b 42 41 41 4d
  Address 0x50: 49 43 33 2d 33 44 2d 31 58 31 30 30 47 45 2d 43
  Address 0x60: 58 50 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 96 c0 03 ef cc 57 79 85 08 00 00 00 02
    PIC 2          BUILTIN          BUILTIN          1X100GE CXP
      Xcvr 0      REV 01      740-046563      XD16FC064      CFP2-100G-SR10
FPC 3          REV 35      750-028467      CAAT9156      MPC 3D 16x 10GE
Jedec Code: 0x7fb0          EEPROM Version: 0x01
P/N: 750-028467          S/N: CAAT9156
Assembly ID: 0x0997          Assembly Version: 01.35
Date: 12-17-2012          Assembly Flags: 0x00
Version: REV 35
ID: MPC 3D 16x 10GE          FRU Model Number: MPC-3D-16XGE-SFPP
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 09 97 01 23 52 45 56 20 33 35 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 32 38 34 36 37 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 54 39 31 35 36 00 11 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 4d
  Address 0x50: 50 43 2d 33 44 2d 31 36 58 47 45 2d 53 46 50 50
  Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
    CPU          REV 11      711-029089      CAAV4645      AMPC PMB
Jedec Code: 0x7fb0          EEPROM Version: 0x01
P/N: 711-029089          S/N: CAAV4645
Assembly ID: 0x0998          Assembly Version: 01.11
Date: 12-13-2012          Assembly Flags: 0x00
Version: REV 11
ID: AMPC PMB
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 09 98 01 0b 52 45 56 20 31 31 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 32 39 30 38 39 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 56 34 36 34 35 00 0d 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
    PIC 0          BUILTIN          BUILTIN          4x 10GE(LAN) SFP+
Jedec Code: 0x0000          EEPROM Version: 0x00
P/N: BUILTIN          S/N: BUILTIN
Assembly ID: 0x02fe          Assembly Version: 00.00
Date: 00-00-0000          Assembly Flags: 0x00
ID: 4x 10GE(LAN) SFP+
Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
  Address 0x00: 00 00 00 00 02 fe 00 00 00 00 00 00 00 00 00 00

```

```

Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 6b 94 00 00 00 00 02 fe 00 00
  Xcvr 0      REV 01  740-021308  AQ43HZ1      SFP+-10G-SR
  Xcvr 1      REV 01  740-021308  AQ43HZC      SFP+-10G-SR
  Xcvr 2      REV 01  740-021308  AQ43HD2      SFP+-10G-SR
  Xcvr 3      REV 01  740-021308  AQ502HN      SFP+-10G-SR
PIC 1        BUILTIN      BUILTIN      4x 10GE(LAN) SFP+
Jedec Code:  0x0000      EEPROM Version: 0x00
P/N:         BUILTIN      S/N:         BUILTIN
Assembly ID: 0x02fe      Assembly Version: 00.00
Date:        00-00-0000   Assembly Flags: 0x00
ID: 4x 10GE(LAN) SFP+
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 02 fe 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 ac 0c 00 00 00 00 02 fe 00 00
  Xcvr 0      REV 01  740-021308  AQ43HGF      SFP+-10G-SR
  Xcvr 1      REV 01  740-021308  AQ501RZ      SFP+-10G-SR
  Xcvr 2      REV 01  740-021308  AQ5029V      SFP+-10G-SR
  Xcvr 3      REV 01  740-021308  AQ501X9      SFP+-10G-SR
PIC 2        BUILTIN      BUILTIN      4x 10GE(LAN) SFP+
Jedec Code:  0x0000      EEPROM Version: 0x00
P/N:         BUILTIN      S/N:         BUILTIN
Assembly ID: 0x02fe      Assembly Version: 00.00
Date:        00-00-0000   Assembly Flags: 0x00
.....

```

### show chassis hardware models (MX960 Router with MPC5EQ)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
Midplane      REV 01   710-030012  ACAX3674      CHAS-BP-MX960-S
FPM Board     REV 03   710-014974  CAAZ9326      CRAFT-MX960-S
PEM 0         Rev 10   740-027760  QCS1702N062   PWR-MX960-4100-AC-S
PEM 1         Rev 04   740-027760  QCS1422N02C   PWR-MX960-4100-AC-S
PEM 2         Rev 09   740-027760  QCS1614N01X   PWR-MX960-4100-AC-S
Routing Engine 0 REV 08   740-031116  9009131803    RE-S-1800X4-16G-S
Routing Engine 1 REV 08   740-031116  9009124913    RE-S-1800X4-16G-S
CB 0          REV 18   750-031391  CABF0579      SCBE-MX-S
CB 1          REV 16   750-031391  CAAZ2471      SCBE-MX-S
CB 2          REV 16   750-031391  CAAW9595      SCBE-MX-S
FPC 0         REV 18   750-046005  CACE6574      PROTO-ASSEMBLY
FPC 1         REV 11   750-045372  CABK8154      MX-MPC3E-3D
  MIC 0       REV 07   750-033307  CABD5255      MIC3-3D-10XGE-SFPP
  MIC 1       REV 14   750-033196  CAAP1398      MIC3-3D-1X100GE-CXP
FPC 3         REV 35   750-028467  CAAT9156      MPC-3D-16XGE-SFPP
FPC 4         REV 18   750-046005  CACE6568      PROTO-ASSEMBLY
FPC 5         REV 18   750-046005  CACE6577      PROTO-ASSEMBLY

```

|            |             |            |          |                     |
|------------|-------------|------------|----------|---------------------|
| FPC 7      | REV 09      | 750-037355 | CAAF0937 | MPC4E-2CGE-8XGE     |
| FPC 8      | REV 39      | 750-045715 | CACD1903 | PROTO-ASSEMBLY      |
| FPC 9      | REV 05      | 750-044444 | CAAY9801 | MX-MPC2E-3D-P       |
| MIC 0      | REV 28      | 750-028387 | CAAX1071 | MIC-3D-4XGE-XFP     |
| FPC 10     | REV 21.0.11 | 750-045715 | CAAY3541 | PROTO-ASSEMBLY      |
| FPC 11     | REV 17      | 750-037355 | CAAT3986 | MPC4E-3D-2CGE-8XGE  |
| Fan Tray 0 | REV 08      | 740-031521 | ACAF4219 | FFANTRAY-MX960-HC-S |
| Fan Tray 1 | REV 08      | 740-031521 | ACAF4225 | FFANTRAY-MX960-HC-S |

#### show chassis hardware clei-models (MX960 Router with MPC5EQ)

```
user@host> show chassis hardware clei-models
```

Hardware inventory:

| Item             | Version     | Part number | CLEI code  | FRU model number    |
|------------------|-------------|-------------|------------|---------------------|
| Midplane         | REV 01      | 710-030012  | COM8T00CRB | CHAS-BP-MX960-S     |
| FPM Board        | REV 03      | 710-014974  |            | CRAFT-MX960-S       |
| PEM 0            | Rev 10      | 740-027760  |            | PWR-MX960-4100-AC-S |
| PEM 1            | Rev 04      | 740-027760  |            | PWR-MX960-4100-AC-S |
| PEM 2            | Rev 09      | 740-027760  |            | PWR-MX960-4100-AC-S |
| Routing Engine 0 | REV 08      | 740-031116  | COUCASKBAA | RE-S-1800X4-16G-S   |
| Routing Engine 1 | REV 08      | 740-031116  | COUCASKBAA | RE-S-1800X4-16G-S   |
| CB 0             | REV 18      | 750-031391  | COUCASRBAA | SCBE-MX-S           |
| CB 1             | REV 16      | 750-031391  | COUCARCBAB | SCBE-MX-S           |
| CB 2             | REV 16      | 750-031391  | COUCARCBAB | SCBE-MX-S           |
| FPC 0            | REV 18      | 750-046005  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 1            | REV 11      | 750-045372  | COUIBBNBAA | MX-MPC3E-3D         |
| MIC 0            | REV 07      | 750-033307  | COUIBBJBAA | MIC3-3D-10XGE-SFPP  |
| MIC 1            | REV 14      | 750-033196  | COUIBBKBAA | MIC3-3D-1X100GE-CXP |
| FPC 3            | REV 35      | 750-028467  |            | MPC-3D-16XGE-SFPP   |
| FPC 4            | REV 18      | 750-046005  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 5            | REV 18      | 750-046005  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 7            | REV 09      | 750-037355  | PROTOXCLEI | MPC4E-2CGE-8XGE     |
| FPC 8            | REV 39      | 750-045715  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 9            | REV 05      | 750-044444  | COUIBBGBAA | MX-MPC2E-3D-P       |
| MIC 0            | REV 28      | 750-028387  | COUIA16BAA | MIC-3D-4XGE-XFP     |
| FPC 10           | REV 21.0.11 | 750-045715  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 11           | REV 17      | 750-037355  | IPU3A4DHAA | MPC4E-3D-2CGE-8XGE  |
| Fan Tray 0       | REV 08      | 740-031521  |            | FFANTRAY-MX960-HC-S |
| Fan Tray 1       | REV 08      | 740-031521  |            | FFANTRAY-MX960-HC-S |

#### show chassis hardware (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item             | Version | Part number | Serial number | Description               |
|------------------|---------|-------------|---------------|---------------------------|
| Chassis          |         |             | JN123F6D9AFA  | MX960                     |
| Midplane         | REV 04  | 750-047849  | ACRC8764      | Enhanced MX960 Backplane  |
| FPM Board        | REV 03  | 710-014974  | CACS4395      | Front Panel Display       |
| PDM              | Rev 03  | 740-013110  | QCS1809500Z   | Power Distribution Module |
| PEM 0            | Rev 08  | 740-029344  | QCS1817V0LK   | DC 4.1kW Power Entry      |
| Module           |         |             |               |                           |
| PEM 1            | Rev 08  | 740-029344  | QCS1814V01F   | DC 4.1kW Power Entry      |
| Module           |         |             |               |                           |
| PEM 2            | Rev 08  | 740-029344  | QCS1810V1EW   | DC 4.1kW Power Entry      |
| Module           |         |             |               |                           |
| PEM 3            | Rev 08  | 740-029344  | QCS1810V1K5   | DC 4.1kW Power Entry      |
| Module           |         |             |               |                           |
| Routing Engine 0 | REV 11  | 740-031116  | 9013103483    | RE-S-1800x4               |
| Routing Engine 1 | REV 10  | 740-031116  | 9009198513    | RE-S-1800x4               |
| CB 0             | REV 23  | 750-031391  | CADW3218      | Enhanced MX SCB           |
| CB 1             | REV 14  | 750-031391  | ABBK5220      | Enhanced MX SCB           |

|            |        |            |             |                       |
|------------|--------|------------|-------------|-----------------------|
| FPC 1      | REV 14 | 750-045372 | CADK0464    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADM9839    | HMPC PMB 2G           |
| MIC 0      | REV 19 | 750-033199 | CAAE5870    | 1X100GE CFP           |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE CFP           |
| Xcvr 0     | REV 01 | 740-032210 | UTHOH0W     | CFP-100G-LR4          |
| FPC 2      | REV 14 | 750-045372 | CADN3262    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADN8129    | HMPC PMB 2G           |
| FPC 3      | REV 14 | 750-045372 | CADH0146    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADT2458    | HMPC PMB 2G           |
| MIC 0      | REV 03 | 750-057666 | CADP1386    | 1X100GE DWDM CFP2-ACO |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE DWDM CFP2-ACO |
| Xcvr 0     | REV 01 | 740-062357 | SMD5136.1   | OTN-100G-LH           |
| FPC 4      | REV 18 | 750-045372 | CAEV5668    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CAET7827    | HMPC PMB 2G           |
| FPC 7      | REV 14 | 750-045372 | CADJ1947    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADJ1561    | HMPC PMB 2G           |
| MIC 0      | REV 05 | 750-057666 | CAEB5763    | 1X100GE DWDM CFP2-ACO |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE DWDM CFP2-ACO |
| Xcvr 0     | REV 01 | 740-062357 | 1DJBZ052002 | OTN-100G-LH           |
| FPC 8      | REV 14 | 750-045372 | CADK0485    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADM9828    | HMPC PMB 2G           |
| MIC 0      | REV 03 | 750-057666 | CADP1390    | 1X100GE DWDM CFP2-ACO |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE DWDM CFP2-ACO |
| FPC 9      | REV 14 | 750-045372 | CADJ1936    | MPCE Type 3 3D        |
| CPU        | REV 10 | 711-035209 | CADJ1566    | HMPC PMB 2G           |
| MIC 0      | REV 14 | 750-057666 | CAFF7544    | 1X100GE DWDM CFP2-ACO |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE DWDM CFP2-ACO |
| Xcvr 0     | REV 01 | 740-062357 | 1DJBZ05100K | OTN-100G-LH           |
| FPC 10     | REV 14 | 750-054901 | CADJ3846    | MPC3E NG HQoS         |
| CPU        | REV 11 | 711-045719 | CADN5471    | RMPC PMB              |
| MIC 0      | REV 05 | 750-057666 | CAEB5760    | 1X100GE DWDM CFP2-ACO |
| PIC 0      |        | BUILTIN    | BUILTIN     | 1X100GE DWDM CFP2-ACO |
| Xcvr 0     | REV 01 | 740-062357 | SMD5091.1   | CFP-Loopback          |
| Fan Tray 0 | REV 08 | 740-031521 | ACDB4083    | Enhanced Fan Tray     |
| Fan Tray 1 | REV 08 | 740-031521 | ACDB3995    | Enhanced Fan Tray     |

### show chassis hardware clei-models(MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```
user@host> show chassis hardware clei-models
```

| Hardware inventory: |         |             |            |                     |
|---------------------|---------|-------------|------------|---------------------|
| Item                | Version | Part number | CLEI code  | FRU model number    |
| Midplane            | REV 04  | 750-047849  | CMMJA10BRA | CHAS-BP3-MX960-S    |
| FPM Board           | REV 03  | 710-014974  |            | CRAFT-MX960-S       |
| PEM 0               | Rev 08  | 740-029344  |            | PWR-MX960-4100-DC-S |
| PEM 1               | Rev 08  | 740-029344  |            | PWR-MX960-4100-DC-S |
| PEM 2               | Rev 08  | 740-029344  |            | PWR-MX960-4100-DC-S |
| PEM 3               | Rev 08  | 740-029344  |            | PWR-MX960-4100-DC-S |
| Routing Engine 0    | REV 11  | 740-031116  | COUCASYBAB | RE-S-1800X4-16G-S   |
| Routing Engine 1    | REV 10  | 740-031116  | COUCASYBAA | RE-S-1800X4-16G-S   |
| CB 0                | REV 23  | 750-031391  | COUCATXBAA | SCBE-MX-S           |
| CB 1                | REV 14  | 750-031391  | COUCARCBAA | SCBE-MX-S           |
| FPC 1               | REV 14  | 750-045372  | COUIBBNBAB | MX-MPC3E-3D         |
| MIC 0               | REV 19  | 750-033199  | COUIBA8BAA | MIC3-3D-1X100GE-CFP |
| FPC 2               | REV 14  | 750-045372  | COUIBBNBAB | MX-MPC3E-3D         |
| FPC 3               | REV 14  | 750-045372  | COUIBBNBAB | MX-MPC3E-3D         |
| MIC 0               | REV 03  | 750-057666  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 4               | REV 18  | 750-045372  | COUIBBNBAC | MX-MPC3E-3D         |
| FPC 7               | REV 14  | 750-045372  | COUIBBNBAB | MX-MPC3E-3D         |
| MIC 0               | REV 05  | 750-057666  | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 8               | REV 14  | 750-045372  | COUIBBNBAB | MX-MPC3E-3D         |
| MIC 0               | REV 03  | 750-057666  | PROTOXCLEI | PROTO-ASSEMBLY      |

|            |        |            |            |                     |
|------------|--------|------------|------------|---------------------|
| FPC 9      | REV 14 | 750-045372 | COUIBBNBAB | MX-MPC3E-3D         |
| MIC 0      | REV 14 | 750-057666 | PROTOXCLEI | PROTO-ASSEMBLY      |
| FPC 10     | REV 14 | 750-054901 | PROTOXCLEI | PROTO-ASSEMBLY      |
| MIC 0      | REV 05 | 750-057666 | PROTOXCLEI | PROTO-ASSEMBLY      |
| Fan Tray 0 | REV 08 | 740-031521 |            | FFANTRAY-MX960-HC-S |
| Fan Tray 1 | REV 08 | 740-031521 |            | FFANTRAY-MX960-HC-S |

### show chassis hardware (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

```

user@host> show chassis hardware
Hardware inventory:
Item                Version  Part number  Serial number  Description
Chassis              JN123AC42AJC PTX3000
Midplane             REV 22   750-044645  ACLP6640      Backplane
FPM                   REV 07   760-044663  ACMX2146      Front Panel Display
PSM 1                 REV 02   740-044980  1EDD3080169   DC 12V Power Supply
PSM 2                 REV 06   740-044981  1EDK5040563   AC 12V Power Supply
PSM 3                 REV 06   740-044981  1EDK5040313   AC 12V Power Supply
PSM 4                 REV 04   740-044980  1EDJ3330088   DC 12V Power Supply
Routing Engine 0     REV 12   740-026942  P737A-006029  RE-DUO-2600
CB 0                  REV 18   750-044656  ACMZ3179      Control Board
FPC 2                 REV 06   750-057064  ACAM6098      FPC3-SFF-PTX-1X
CPU                   BUILTIN    BUILTIN      SMPC PMB
PIC 0                 REV 17   750-059747  ACNW3510      5X100GE DWDM CFP2-ACO
  Xcvr 0               REV 01   740-062357  1DJBZ040003   OTN-100G-LH
  Xcvr 2               REV 01   740-062357  1DJBZ044004   OTN-100G-LH
  Xcvr 3               REV 01   740-062357  1DJBZ03500P    OTN-100G-LH
  Xcvr 4               REV 01   740-062357  1DJBZ03700C    OTN-100G-LH
FPC 4                 REV 12   750-057064  ACAM7153      FPC3-SFF-PTX-1X
CPU                   BUILTIN    BUILTIN      SMPC PMB
PIC 0                 REV 17   750-059747  ACNW3511      5X100GE DWDM CFP2-ACO
  Xcvr 0               REV 01   740-061663  47             OTN-100G-LH
  Xcvr 1               REV 01   740-061663  39             OTN-100G-LH
  Xcvr 2               REV 01   740-062357  1DJBZ044002    OTN-100G-LH
  Xcvr 3               REV 01   740-062357  1DJBZ03700G    OTN-100G-LH
  Xcvr 4               REV 01   740-062357  1DJBZ041001    OTN-100G-LH
FPC 8                 REV 11   750-057064  ACAM6808      FPC3-SFF-PTX-1X
CPU                   BUILTIN    BUILTIN      SMPC PMB
PIC 0                 REV 17   750-059747  ACNW3508      5X100GE DWDM CFP2-ACO
  Xcvr 0               REV 01   740-061663  194            OTN-100G-LH
  Xcvr 1               REV 01   740-061663  168            OTN-100G-LH
  Xcvr 2               REV 01   740-061663  52             OTN-100G-LH
  Xcvr 3               REV 01   740-061663  85             OTN-100G-LH
  Xcvr 4               REV 01   740-061663  218            OTN-100G-LH
SIB 0                 REV 03   750-057067  ACAM8513      SIB3-SFF-PTX
SIB 1                 REV 01   750-057067  ACAM5918      SIB3-SFF-PTX
SIB 2                 REV 01   711-057066  ACAM4325      SIB3-SFF-PTX
SIB 3                 REV 01   711-057066  ACAM4328      SIB3-SFF-PTX
SIB 4                 REV 01   711-057066  ACAM4349      SIB3-SFF-PTX
SIB 5                 REV 01   711-057066  ACAM4323      SIB3-SFF-PTX
SIB 6                 REV 01   711-057066  ACAM4344      SIB3-SFF-PTX
SIB 7                 REV 01   750-057067  ACAM4346      SIB3-SFF-PTX
SIB 8                 REV 01   750-057067  ACAM5911      SIB3-SFF-PTX
Fan Tray 0            REV 13   760-044659  ACMP6395      Fan Tray (Exhaust)
Fan Tray 1            REV 13   760-044659  ACMZ6957      Fan Tray (Exhaust)

```

### show chassis hardware clei-models (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

```

user@host> show chassis hardware clei-models
Hardware inventory:
Item                Version  Part number  CLEI code  FRU model number

```

|                  |        |            |            |                       |
|------------------|--------|------------|------------|-----------------------|
| Midplane         | REV 22 | 750-044645 | IPMVN10FRA | CHAS-MP-PTX3000-S     |
| FPM              | REV 07 | 760-044663 | IPUCBE5CAA | FPD-SFF-PTX-S         |
| PSM 1            | REV 02 | 740-044980 | PROTOPWRDC | PSM-SFF-PTX-DC-2200-S |
| PSM 2            | REV 06 | 740-044981 | IPUPAK0KAB | PSM-SFF-PTX-AC-S      |
| PSM 3            | REV 06 | 740-044981 | IPUPAK0KAB | PSM-SFF-PTX-AC-S      |
| PSM 4            | REV 04 | 740-044980 | IPUPAK1KAA | PSM-SFF-PTX-DC-S      |
| Routing Engine 0 | REV 12 | 740-026942 |            | RE-DUO-C2600-16G-S    |
| CB 0             | REV 18 | 750-044656 | IPUCBE6CAB | CB-SFF-PTX-S          |
| FPC 2            | REV 06 | 750-057064 | PROTOXCLEI | PROTO-ASSEMBLY        |
| PIC 0            | REV 17 | 750-059747 | IPU3BC5HAA | PTX-5-100G-WDM        |
| FPC 4            | REV 12 | 750-057064 |            |                       |
| PIC 0            | REV 17 | 750-059747 | IPU3BC5HAA | PTX-5-100G-WDM        |
| FPC 8            | REV 11 | 750-057064 |            |                       |
| PIC 0            | REV 17 | 750-059747 | IPU3BC5HAA | PTX-5-100G-WDM        |
| SIB 0            | REV 03 | 750-057067 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 1            | REV 01 | 750-057067 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 2            | REV 01 | 711-057066 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 3            | REV 01 | 711-057066 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 4            | REV 01 | 711-057066 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 5            | REV 01 | 711-057066 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 6            | REV 01 | 711-057066 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 7            | REV 01 | 750-057067 | PROTOXCLEI | PROTO-ASSEMBLY        |
| SIB 8            | REV 01 | 750-057067 | PROTOXCLEI | PROTO-ASSEMBLY        |
| Fan Tray 0       | REV 13 | 760-044659 | IPUCBE8CAA | FAN-SFF-PTX-S         |
| Fan Tray 1       | REV 13 | 760-044659 | IPUCBE8CAA | FAN-SFF-PTX-S         |

#### show chassis hardware (MX2010 Router)

```
user@host > show chassis hardware
```

```
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description          |
|------------------|---------|-------------|---------------|----------------------|
| Chassis          |         |             | JN11E3217AFK  | MX2010               |
| Midplane         | REV 01  | 750-044636  | ABAB8506      | Lower Backplane      |
| Midplane 1       | REV 01  | 711-044557  | ZY8296        | Upper Backplane      |
| PMP              | REV 03  | 711-032426  | ACA11388      | Power Midplane       |
| FPM Board        | REV 06  | 711-032349  | ZX8744        | Front Panel Display  |
| PSM 4            | REV 0C  | 740-033727  | VK00254       | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 5            | REV 0B  | 740-033727  | VG00015       | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 6            | REV 0B  | 740-033727  | VH00097       | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 7            | REV 0C  | 740-033727  | VJ00151       | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 8            | REV 0C  | 740-033727  | VJ00149       | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PDM 0            | REV 0B  | 740-038109  | WA00008       | DC Power Dist Module |
| PDM 1            | REV 0B  | 740-038109  | WA00014       | DC Power Dist Module |
| Routing Engine 0 | REV 02  | 740-041821  | 9009094134    | RE-S-1800x4          |
| Routing Engine 1 | REV 02  | 740-041821  | 9009094141    | RE-S-1800x4          |
| CB 0             | REV 08  | 750-040257  | CAAB3491      | Control Board        |
| CB 1             | REV 08  | 750-040257  | CAAB3489      | Control Board        |
| SPMB 0           | REV 02  | 711-041855  | CAA6135       | PMB Board            |
| SPMB 1           | REV 02  | 711-041855  | CAA6137       | PMB Board            |
| SFB 0            | REV 06  | 711-032385  | ZV1828        | Switch Fabric Board  |
| SFB 1            | REV 07  | 711-032385  | ZZ2568        | Switch Fabric Board  |
| SFB 2            | REV 07  | 711-032385  | ZZ2563        | Switch Fabric Board  |
| SFB 3            | REV 07  | 711-032385  | ZZ2564        | Switch Fabric Board  |
| SFB 4            | REV 07  | 711-032385  | ZZ2580        | Switch Fabric Board  |
| SFB 5            | REV 07  | 711-032385  | ZZ2579        | Switch Fabric Board  |
| SFB 6            | REV 07  | 711-032385  | CAAB4882      | Switch Fabric Board  |

|        |        |            |              |                     |
|--------|--------|------------|--------------|---------------------|
| SFB 7  | REV 07 | 711-032385 | CAAB4898     | Switch Fabric Board |
| FPC 0  | REV 33 | 750-028467 | CAAB1919     | MPC 3D 16x 10GE     |
| CPU    | REV 11 | 711-029089 | CAAB7174     | AMPC PMB            |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+   |
| Xcvr 0 | REV 01 | 740-021308 | AMH02RE      | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-021308 | AMH038C      | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-021308 | AMH0390      | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-021308 | AMG0SUA      | SFP+-10G-SR         |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+   |
| Xcvr 0 | REV 01 | 740-021308 | AMH0579      | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-021308 | AMG0SGP      | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-021308 | AMH04SV      | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-021308 | AMH04X3      | SFP+-10G-SR         |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+   |
| Xcvr 0 | REV 01 | 740-021308 | AMH0135      | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-021308 | AMH02NC      | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-021308 | AMH02XB      | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-021308 | AMH02PN      | SFP+-10G-SR         |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+   |
| Xcvr 0 | REV 01 | 740-021308 | AMH057Y      | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-021308 | AMG0JHE      | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-021308 | AMH02HT      | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-021308 | AMH04V4      | SFP+-10G-SR         |
| FPC 1  | REV 21 | 750-033205 | ZG5027       | MPC Type 3          |
| CPU    | REV 04 | 711-035209 | YT4780       | HMPC PMB 2G         |
| MIC 0  | REV 03 | 750-033307 | ZV6299       | 10X10GE SFPP        |
| PIC 0  |        | BUILTIN    | BUILTIN      | 10X10GE SFPP        |
| Xcvr 0 | REV 01 | 740-031980 | 083363A00410 | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-031980 | 083363A00334 | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-031980 | 113363A00125 | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-031980 | 083363A00953 | SFP+-10G-SR         |
| Xcvr 4 | REV 01 | 740-031980 | AHR013D      | SFP+-10G-SR         |
| Xcvr 5 | REV 01 | 740-031980 | AJ40JUR      | SFP+-10G-SR         |
| Xcvr 6 | REV 01 | 740-031980 | AJ40JKL      | SFP+-10G-SR         |
| Xcvr 7 | REV 01 | 740-031980 | AJ30ECK      | SFP+-10G-SR         |
| Xcvr 8 | REV 01 | 740-021308 | 19T511100864 | SFP+-10G-SR         |
| Xcvr 9 | REV 01 | 740-021308 | 19T511100868 | SFP+-10G-SR         |
| MIC 1  | REV 03 | 750-033307 | ZV6268       | 10X10GE SFPP        |
| PIC 2  |        | BUILTIN    | BUILTIN      | 10X10GE SFPP        |
| Xcvr 0 | REV 01 | 740-031980 | AJCOJML      | SFP+-10G-SR         |
| Xcvr 1 | REV 01 | 740-031980 | AJ403PC      | SFP+-10G-SR         |
| Xcvr 2 | REV 01 | 740-031980 | AJ10N25      | SFP+-10G-SR         |
| Xcvr 3 | REV 01 | 740-031980 | AJ40JF4      | SFP+-10G-SR         |
| Xcvr 4 | REV 01 | 740-031980 | AJ40JSJ      | SFP+-10G-SR         |
| Xcvr 5 | REV 01 | 740-031980 | AJ403V7      | SFP+-10G-SR         |
| Xcvr 6 | REV 01 | 740-031980 | AJ40JN3      | SFP+-10G-SR         |
| Xcvr 7 | REV 01 | 740-031980 | AJ40JSU      | SFP+-10G-SR         |
| Xcvr 8 | REV 01 | 740-021308 | 19T511100468 | SFP+-10G-SR         |
| Xcvr 9 | REV 01 | 740-021308 | 19T511101363 | SFP+-10G-SR         |
| FPC 8  | REV 22 | 750-031089 | ZT9746       | MPC Type 2 3D       |
| CPU    | REV 06 | 711-030884 | ZS1271       | MPC PMB 2G          |
| MIC 0  | REV 26 | 750-028392 | ABBS1150     | 3D 20x 1GE(LAN) SFP |
| PIC 0  |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) SFP    |
| Xcvr 0 | REV 01 | 740-031851 | PLG023C      | SFP-SX              |
| Xcvr 1 | REV 01 | 740-031851 | PLG09C6      | SFP-SX              |
| Xcvr 2 | REV 02 | 740-011613 | AM0950SF9L7  | SFP-SX              |
| Xcvr 3 | REV 02 | 740-011613 | AM1001SFN1H  | SFP-SX              |
| Xcvr 4 | REV 02 | 740-011613 | AM1001SFM9D  | SFP-SX              |
| Xcvr 5 | REV 02 | 740-011613 | AM1001SFLTJ  | SFP-SX              |
| Xcvr 6 | REV 01 | 740-031851 | AC1108S03L9  | SFP-SX              |
| Xcvr 7 | REV 01 | 740-031851 | AC1102S00NC  | SFP-SX              |



|            |        |            |              |                        |
|------------|--------|------------|--------------|------------------------|
| Xcvr 8     | REV 01 | 740-031851 | AC1102S00MX  | SFP-SX                 |
| Xcvr 9     | REV 01 | 740-031851 | AC1102S0085  | SFP-SX                 |
| PIC 1      |        | BUILTIN    | BUILTIN      | 10x 1GE(LAN) SFP       |
| Xcvr 0     | REV 01 | 740-031851 | AC1102S00KU  | SFP-SX                 |
| Xcvr 1     | REV 01 | 740-031851 | AC1102S00NG  | SFP-SX                 |
| Xcvr 2     | REV 01 | 740-031851 | AC1102S00K3  | SFP-SX                 |
| Xcvr 3     | REV 01 | 740-031851 | AC1102S008R  | SFP-SX                 |
| Xcvr 4     | REV 01 | 740-031851 | AM1107SUFVJ  | SFP-SX                 |
| Xcvr 5     | REV 01 | 740-031851 | AC1108S03LG  | SFP-SX                 |
| MIC 1      | REV 26 | 750-028387 | ABBR9582     | 3D 4x 10GE XFP         |
| PIC 2      |        | BUILTIN    | BUILTIN      | 2x 10GE XFP            |
| Xcvr 0     |        | NON-JNPR   | T10A91703    | XFP-10G-SR             |
| Xcvr 1     |        | NON-JNPR   | T09L42604    | XFP-10G-SR             |
| PIC 3      |        | BUILTIN    | BUILTIN      | 2x 10GE XFP            |
| FPC 9      | REV 11 | 750-036284 | ZL3591       | MPC 3D 16x 10GE EM     |
| CPU        | REV 10 | 711-029089 | ZL0513       | AMPC PMB               |
| PIC 0      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-031980 | 1YT517101825 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | 1YT517101821 | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | 1YT517101682 | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | ALQ13R6      | SFP+-10G-SR            |
| PIC 1      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-031980 | 1YT517101828 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | 1YT517101716 | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | 1YT517101732 | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | ALP0TR1      | SFP+-10G-SR            |
| PIC 2      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-031980 | 1YT517101741 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | 1YT517101829 | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | 1YT517101669 | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | ALQ14E3      | SFP+-10G-SR            |
| PIC 3      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-031980 | 1YT517101826 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | 1YT517101817 | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | 1YT517101735 | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | ALQ159A      | SFP+-10G-SR            |
| ADC 0      | REV 05 | 750-043596 | CAAC2073     | Adapter Card           |
| ADC 1      | REV 01 | 750-043596 | ZV4117       | Adapter Card           |
| ADC 8      | REV 01 | 750-043596 | ZV4107       | Adapter Card           |
| ADC 9      | REV 02 | 750-043596 | ZW1555       | Adapter Card           |
| Fan Tray 0 | REV 2A | 760-046960 | ACAY0015     | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 2A | 760-046960 | ACAY0019     | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 2A | 760-046960 | ACAY0020     | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 2A | 760-046960 | ACAY0021     | 172mm FanTray - 6 Fans |

#### show chassis hardware detail (MX2010 Router)

```
user@host > show chassis hardware detail
```

```
Hardware inventory:
```

| Item       | Version | Part number | Serial number | Description         |
|------------|---------|-------------|---------------|---------------------|
| Chassis    |         |             | JN11E233DAFK  | MX2010              |
| Midplane   | REV 26  | 750-044636  | ABAB9357      | Lower Backplane     |
| Midplane 1 | REV 01  | 711-044557  | ABAB8643      | Upper Backplane     |
| PMP        | REV 04  | 711-032426  | ACAJ1677      | Power Midplane      |
| FPM Board  | REV 08  | 760-044634  | ABBV9726      | Front Panel Display |
| PSM 0      | REV 01  | 740-045050  | 1E02224000P   | DC 52V Power Supply |
| Module     |         |             |               |                     |
| PSM 1      | REV 01  | 740-045050  | 1E02224000M   | DC 52V Power Supply |
| Module     |         |             |               |                     |
| PSM 2      | REV 01  | 740-045050  | 1E022240010   | DC 52V Power Supply |
| Module     |         |             |               |                     |

|                  |        |                        |                          |                      |
|------------------|--------|------------------------|--------------------------|----------------------|
| PSM 3 Module     | REV 01 | 740-045050             | 1E02224000G              | DC 52V Power Supply  |
| PSM 4 Module     | REV 01 | 740-045050             | 1E022240013              | DC 52V Power Supply  |
| PSM 5 Module     | REV 01 | 740-045050             | 1E022240007              | DC 52V Power Supply  |
| PSM 6 Module     | REV 01 | 740-045050             | 1E02224001C              | DC 52V Power Supply  |
| PSM 7 Module     | REV 01 | 740-045050             | 1E02224001D              | DC 52V Power Supply  |
| PSM 8 Module     | REV 01 | 740-045050             | 1E02224001B              | DC 52V Power Supply  |
| PDM 0            | REV 01 | 740-045234             | 1E262250067              | DC Power Dist Module |
| Routing Engine 0 | REV 02 | 740-041821             | 9009099704               | RE-S-1800x4          |
| ad0 3831 MB      |        | UGB30SFA4000T1         | SFA4000T1 00000651       | Compact Flash        |
| ad1 30533 MB     |        | UGB94BPH32H0S1-KCI     | 11000019592              | Disk 1               |
| usb0 (addr 1)    |        | EHCI root hub 0        | Intel                    | uhub0                |
| usb0 (addr 2)    |        | product 0x0020 32      | vendor 0x8087            | uhub1                |
| DIMM 0           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54        | MFR ID-ce80          |
| DIMM 1           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54        | MFR ID-ce80          |
| DIMM 2           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54        | MFR ID-ce80          |
| DIMM 3           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54        | MFR ID-ce80          |
| Routing Engine 1 | REV 02 | 740-041821             | 9009099706               | RE-S-1800x4          |
| ad0 3998 MB      |        | Virtium - TuffDrive    | VCF P1T0200262860208 114 | Compact Flash        |
| ad1 30533 MB     |        | UGB94ARF32H0S3-KC      | UNIGEN-499551-000404     | Disk 1               |
| CB 0             | REV 13 | 750-040257             | CAAF8436                 | Control Board        |
| CB 1             | REV 13 | 750-040257             | CAAF8434                 | Control Board        |
| SPMB 0           | REV 02 | 711-041855             | ABBV3825                 | PMB Board            |
| SPMB 1           | REV 02 | 711-041855             | ABBV3833                 | PMB Board            |
| SFB 0            | REV 05 | 711-044466             | ABBX5682                 | Switch Fabric Board  |
| SFB 1            | REV 05 | 711-044466             | ABBX5676                 | Switch Fabric Board  |
| SFB 2            | REV 05 | 711-044466             | ABBX5665                 | Switch Fabric Board  |
| SFB 3            | REV 05 | 711-044466             | ABBX5699                 | Switch Fabric Board  |
| SFB 4            | REV 05 | 711-044466             | ABBX5603                 | Switch Fabric Board  |
| SFB 5            | REV 05 | 711-044466             | ABBX5587                 | Switch Fabric Board  |
| SFB 6            | REV 05 | 711-044466             | ABBX5607                 | Switch Fabric Board  |
| SFB 7            | REV 05 | 711-044466             | ABBX5669                 | Switch Fabric Board  |
| FPC 0            | REV 09 | 750-037355             | CAAF0924                 | MPC Type 4-2         |
| CPU              | REV 08 | 711-035209             | CAAB9842                 | HMPC PMB 2G          |
| PIC 0            |        | BUILTIN                | BUILTIN                  | 4x10GE SFPP          |
| Xcvr 0           | REV 01 | 740-021308             | 19T511101656             | SFP+-10G-SR          |
| Xcvr 1           | REV 01 | 740-031980             | AMA04RU                  | SFP+-10G-SR          |
| Xcvr 2           | REV 01 | 740-031980             | 193363A00558             | SFP+-10G-SR          |
| Xcvr 3           | REV 01 | 740-031980             | B10M00202                | SFP+-10G-SR          |
| PIC 1            |        | BUILTIN                | BUILTIN                  | 1X100GE CFP          |
| Xcvr 0           |        | NON-JNPR               | X12J00328                | CFP-100G-SR10        |
| PIC 2            |        | BUILTIN                | BUILTIN                  | 4x10GE SFPP          |
| Xcvr 0           | REV 01 | 740-031980             | AMA088W                  | SFP+-10G-SR          |
| Xcvr 1           | REV 01 | 740-031980             | B10L04211                | SFP+-10G-SR          |
| Xcvr 2           | REV 01 | 740-021308             | 19T511101602             | SFP+-10G-SR          |
| Xcvr 3           | REV 01 | 740-031980             | B10L04151                | SFP+-10G-SR          |
| PIC 3            |        | BUILTIN                | BUILTIN                  | 1X100GE CFP          |
| Xcvr 0           |        | NON-JNPR               | X12J00332                | CFP-100G-SR10        |
| FPC 1            | REV 18 | 750-033205             | ZE0128                   | MPC Type 3           |
| CPU              | REV 06 | 711-035209             | ZG5431                   | HMPC PMB 2G          |
| MIC 0            | REV 15 | 750-033199             | ZP6435                   | 1X100GE CFP          |
| PIC 0            |        | BUILTIN                | BUILTIN                  | 1X100GE CFP          |
| Xcvr 0           | REV 01 | 740-032210             | J11E46118                | CFP-100G-LR4         |
| MIC 1            | REV 15 | 750-033199             | ZP6442                   | 1X100GE CFP          |
| PIC 2            |        | BUILTIN                | BUILTIN                  | 1X100GE CFP          |
| Xcvr 0           | REV 01 | 740-032210             | UMN03T4                  | CFP-100G-LR4         |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| FPC 2  | REV 16 | 750-037358 | CAAL1001     | MPC Type 4-1      |
| CPU    | REV 08 | 711-035209 | CAAK7927     | HMPD PMB 2G       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 8X10GE SFP        |
| Xcvr 0 | REV 01 | 740-031980 | 193363A00589 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00028 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 193363A00376 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00016 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 193363A00499 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-021308 | 973152A00039 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | B11E01239    | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 973152A00058 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 8X10GE SFP        |
| Xcvr 0 | REV 01 | 740-031980 | B10M00075    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00014 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AMA0638      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00063 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | AMA0629      | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-021308 | 973152A00053 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 193363A00344 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 973152A00046 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 8X10GE SFP        |
| Xcvr 0 | REV 01 | 740-031980 | AMA062M      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00080 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 193363A00580 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00064 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 093363A01494 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-021308 | 973152A00020 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 123363A00047 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 973152A00072 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 8X10GE SFP        |
| Xcvr 0 | REV 01 | 740-021308 | 03DZ06A01033 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00022 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 03DZ06A01026 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00013 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-021308 | 03DZ06A01028 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-021308 | 973152A00079 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-021308 | 03DZ06A01018 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 973152A00025 | SFP+-10G-SR       |
| FPC 3  | REV 33 | 750-028467 | CAAF5400     | MPC 3D 16x 10GE   |
| CPU    | REV 11 | 711-029089 | CAAH7626     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00066 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00021 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 973152A00062 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00027 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00065 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00069 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 973152A00026 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00003 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00035 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00004 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 973152A00049 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00055 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00010 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 973152A00001 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 973152A00073 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 973152A00012 | SFP+-10G-SR       |
| FPC 4  | REV 21 | 750-033205 | ZG5028       | MPC Type 3        |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| CPU    | REV 05 | 711-035209 | YX3911       | HMPC PMB 2G       |
| MIC 0  | REV 03 | 750-036233 | ZL2036       | 2X40GE QSFP       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 2X40GE QSFP       |
| Xcvr 0 | REV 01 | 740-032986 | QB220708     | QSFP+-40G-SR4     |
| Xcvr 1 | REV 01 | 740-032986 | QB220735     | QSFP+-40G-SR4     |
| MIC 1  | REV 03 | 750-036233 | ZL2028       | 2X40GE QSFP       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 2X40GE QSFP       |
| Xcvr 0 | REV 01 | 740-032986 | QB220727     | QSFP+-40G-SR4     |
| Xcvr 1 | REV 01 | 740-032986 | QB220715     | QSFP+-40G-SR4     |
| FPC 5  | REV 11 | 750-037358 | CAAE2196     | MPC Type 4-1      |
| CPU    | REV 08 | 711-035209 | CAAD9074     | HMPC PMB 2G       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | AMA062S      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AMA062P      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AMA052R      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AMA0632      | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 193363A00564 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | 193363A00229 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 193363A00363 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-031980 | 193363A00278 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | AMA04CC      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | AD0927A001W  | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AMA04N2      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AMA062U      | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 193363A00491 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | 183363A01511 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 193363A00565 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-031980 | 193363A00405 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | AMA07QX      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AMA06MS      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 193363A00318 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 193363A00402 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 193363A00174 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | 193363A00388 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 193363A00377 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-031980 | 193363A00234 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | AMA062T      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 193363A00550 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 193363A00364 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AMA0630      | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | 193363A00509 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | 193363A00459 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | 113363A00191 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-031980 | 193363A00352 | SFP+-10G-SR       |
| FPC 6  | REV 33 | 750-028467 | CAAF5552     | MPC 3D 16x 10GE   |
| CPU    | REV 11 | 711-029089 | CAAH7601     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | AD0927A0036  | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | AD0927A003M  | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | AD0927A003G  | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | AD0927A0031  | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 193363A00331 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 193363A00325 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 193363A00417 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A02509 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | T09K75140    | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 1 | REV 01 | 740-031980 | B11A04356    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01952    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01914    | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | T09K75157    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | T09K75194    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01926    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01936    | SFP+-10G-SR       |
| FPC 7  | REV 16 | 750-037358 | CAAL1012     | MPC Type 4-1      |
| CPU    | REV 08 | 711-035209 | CAAJ3851     | HMPC PMB 2G       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | AMA04NK      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11F00260    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11E02192    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AMA04CP      | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | AJ40JJK      | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | B11F00238    | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | B10M00275    | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-031980 | 193363A00211 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | B11D05577    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11G00586    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AMA08B7      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AMA04Q0      | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-031980 | B11D05840    | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-031980 | B11E00467    | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-031980 | B11E00029    | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 19T511101712 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | 193363A00568 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B10M00166    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B10M00212    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11D05823    | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-021308 | 03DZ06A01005 | SFP+-10G-SR       |
| Xcvr 5 | REV 01 | 740-021308 | 03DZ06A01003 | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-021308 | 03DZ06A01009 | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 03DZ06A01004 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 8X10GE SFPP       |
| Xcvr 0 | REV 01 | 740-021308 | 03DZ06A01017 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-021308 | 03DZ06A01016 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | 03DZ06A01024 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | 03DZ06A01008 | SFP+-10G-SR       |
| Xcvr 4 | REV 01 | 740-030658 | AD0946A02UH  | SFP+-10G-USR      |
| Xcvr 5 | REV 01 | 740-021308 | T09J67913    | SFP+-10G-SR       |
| Xcvr 6 | REV 01 | 740-021308 | AD0837ES09G  | SFP+-10G-SR       |
| Xcvr 7 | REV 01 | 740-021308 | 03DZ06A01015 | SFP+-10G-SR       |
| FPC 8  | REV 03 | 750-045372 | CAAD3111     | MPC Type 3        |
| CPU    | REV 08 | 711-035209 | CAAD8033     | HMPC PMB 2G       |
| MIC 0  | REV 03 | 750-036233 | ZL2032       | 2X40GE QSFP       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 2X40GE QSFP       |
| Xcvr 0 | REV 01 | 740-032986 | QB230273     | QSFP+-40G-SR4     |
| Xcvr 1 | REV 01 | 740-032986 | QB230254     | QSFP+-40G-SR4     |
| MIC 1  | REV 03 | 750-036233 | ZL2021       | 2X40GE QSFP       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 2X40GE QSFP       |
| Xcvr 0 | REV 01 | 740-032986 | QB390962     | QSFP+-40G-SR4     |
| Xcvr 1 | REV 01 | 740-032986 | QB390960     | QSFP+-40G-SR4     |
| FPC 9  | REV 09 | 750-037355 | CAAF1531     | MPC Type 4-2      |
| CPU    | REV 08 | 711-035209 | CAAB9927     | HMPC PMB 2G       |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x10GE SFPP       |
| Xcvr 0 | REV 01 | 740-031980 | 193363A00525 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 193363A00504 | SFP+-10G-SR       |

|            |        |            |              |                        |
|------------|--------|------------|--------------|------------------------|
| Xcvr 2     | REV 01 | 740-031980 | 193363A00368 | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | AJ40JSS      | SFP+-10G-SR            |
| PIC 1      |        | BUILTIN    | BUILTIN      | 1X100GE CFP            |
| PIC 2      |        | BUILTIN    | BUILTIN      | 4x10GE SFPP            |
| Xcvr 0     | REV 01 | 740-031980 | 123363A00042 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | B10M00023    | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | AJ802EM      | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | B11E02348    | SFP+-10G-SR            |
| PIC 3      |        | BUILTIN    | BUILTIN      | 1X100GE CFP            |
| ADC 0      | REV 13 | 750-043596 | ABBX5532     | Adapter Card           |
| ADC 1      | REV 13 | 750-043596 | ABBX5550     | Adapter Card           |
| ADC 2      | REV 13 | 750-043596 | ABBX5571     | Adapter Card           |
| ADC 3      | REV 13 | 750-043596 | ABBX5568     | Adapter Card           |
| ADC 4      | REV 13 | 750-043596 | ABBX5556     | Adapter Card           |
| ADC 5      | REV 13 | 750-043596 | ABBX5553     | Adapter Card           |
| ADC 6      | REV 13 | 750-043596 | ABBX5541     | Adapter Card           |
| ADC 7      | REV 13 | 750-043596 | ABBX5578     | Adapter Card           |
| ADC 8      | REV 13 | 750-043596 | ABBX5560     | Adapter Card           |
| ADC 9      | REV 07 | 750-043596 | ABBV7188     | Adapter Card           |
| Fan Tray 0 | REV 03 | 760-046960 | ACAY0127     | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 2A | 760-046960 | ACAY0068     | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 2A | 760-046960 | ACAY0072     | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 2A | 760-046960 | ACAY0070     | 172mm FanTray - 6 Fans |

### show chassis hardware extensive (MX2010 Router)

```

user@host > show chassis hardware extensive
Hardware inventory:
Item              Version  Part number  Serial number  Description
Chassis
Jedec Code:      0x7fb0          EEPROM Version: 0x02
S/N:              JN11E233DAFK
Assembly ID:     0x0557          Assembly Version: 00.00
Date:            00-00-0000      Assembly Flags:  0x00
ID: MX2010
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 05 57 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: 4a 4e 31 31 45 32 33 33 44 41 46 4b 00 00 00 00
Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane
Jedec Code:      0x7fb0          EEPROM Version: 0x02
P/N:              750-044636      S/N:              ABAB9357
Assembly ID:     0x0b66          Assembly Version: 01.26
Date:            08-28-2012      Assembly Flags:  0x00
Version:         REV 26          CLEI Code:        PROTOXCLEI
ID: Lower Backplane              FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
Address 0x00: ad 01 08 00 2c 21 72 70 a0 00 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 66 01 1a 52 45 56 20 32 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 36 33 36 00 00
Address 0x20: 53 2f 4e 20 41 42 41 42 39 33 35 37 00 1c 08 07
Address 0x30: dc ff ff ff ad 01 08 00 2c 21 72 70 a0 00 ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50

```

```

Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff
Midplane 1      REV 01  711-044557  ABAB8643      Upper Backplane
Jedec Code:    0x7fb0      EEPROM Version: 0x01
P/N:          711-044557   S/N:          ABAB8643
Assembly ID:   0x0b65      Assembly Version: 01.01
Date:         07-27-2012   Assembly Flags: 0x00
Version:      REV 01
ID: Upper Backplane
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 0b 65 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 34 34 35 35 37 00 00
Address 0x20: 53 2f 4e 20 41 42 41 42 38 36 34 33 00 1b 07 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
PMP            REV 04  711-032426  ACAJ1677      Power Midplane
Jedec Code:    0x7fb0      EEPROM Version: 0x01
P/N:          711-032426   S/N:          ACAJ1677
Assembly ID:   0x045d      Assembly Version: 01.04
Date:         07-20-2012   Assembly Flags: 0x00
Version:      REV 04
ID: Power Midplane
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 5d 01 04 52 45 56 20 30 34 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 34 32 36 00 00
Address 0x20: 53 2f 4e 20 41 43 41 4a 31 36 37 37 00 14 07 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Board      REV 08  760-044634  ABBV9726      Front Panel Display
Jedec Code:    0x7fb0      EEPROM Version: 0x02
P/N:          760-044634   S/N:          ABBV9726
Assembly ID:   0x0b64      Assembly Version: 01.08
Date:         09-10-2012   Assembly Flags: 0x00
Version:      REV 08      CLEI Code:    IPMYA4EJRA
ID: Front Panel Display   FRU Model Number: MX2010-CRAFT-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 64 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 36 30 2d 30 34 34 36 33 34 00 00
Address 0x20: 53 2f 4e 20 41 42 42 56 39 37 32 36 00 0a 09 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 4d 59 41 34 45 4a 52 41 4d
Address 0x50: 58 32 30 31 30 2d 43 52 41 46 54 2d 53 00 00 00
Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 93 ff ff ff ff ff ff ff ff ff ff ff ff
PSM 0          REV 01  740-045050  1E02224000P   DC 52V Power Supply
Module
Jedec Code:    0x7fb0      EEPROM Version: 0x02
P/N:          740-045050   S/N:          1E02224000P

```

```

Assembly ID: 0x0478      Assembly Version: 01.01
Date: 12-06-2012      Assembly Flags: 0x00
Version: REV 01      CLEI Code: XXXXXXXXXX
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-HC-DC-S-A
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 30 35 30 00 00
  Address 0x20: 31 45 30 32 32 32 34 30 30 30 50 00 00 06 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 58 58 58 58 58 58 58 58 58 58 4d
  Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 48 43 2d 44 43 2d
  Address 0x60: 53 2d 41 00 00 00 31 30 31 ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 4a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 1      REV 01 740-045050 1E02224000M      DC 52V Power Supply
Module
  Jedec Code: 0x7fb0      EEPROM Version: 0x02
  P/N: 740-045050      S/N: 1E02224000M
Assembly ID: 0x0478      Assembly Version: 01.01
Date: 12-06-2012      Assembly Flags: 0x00
Version: REV 01      CLEI Code: XXXXXXXXXX
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-HC-DC-S-A
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 30 35 30 00 00
  Address 0x20: 31 45 30 32 32 32 34 30 30 30 4d 00 00 06 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 58 58 58 58 58 58 58 58 58 58 4d
  Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 48 43 2d 44 43 2d
  Address 0x60: 53 2d 41 00 00 00 31 30 31 ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 4a 00 00 00 00 00 00 00 00 00 00 00 00
...
PDM 0      REV 01 740-045234 1E262250067      DC Power Dist Module
  Jedec Code: 0x7fb0      EEPROM Version: 0x02
  P/N: 740-045234      S/N: 1E262250067
Assembly ID: 0x047b      Assembly Version: 01.01
Date: 06-28-2012      Assembly Flags: 0x00
Version: REV 01      CLEI Code: IPUPAJSKAA
ID: DC Power Dist Module FRU Model Number: MX2000-PDM-DC-S-A
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 7b 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 32 33 34 00 00
  Address 0x20: 31 45 32 36 32 32 35 30 30 36 37 00 00 1c 06 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 55 50 41 4a 53 4b 41 41 4d
  Address 0x50: 58 32 30 30 30 2d 50 44 4d 2d 44 43 2d 53 2d 41
  Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 89 00 00 00 00 00 00 00 00 00 00 00 00
Routing Engine 0 REV 02 740-041821 9009099704      RE-S-1800x4
  Jedec Code: 0x7fb0      EEPROM Version: 0x02
  P/N: 740-041821      S/N: 9009099704
Assembly ID: 0x09c0      Assembly Version: 01.02
Date: 03-15-2012      Assembly Flags: 0x00
Version: REV 02
ID: RE-S-1800x4      FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:

```



```

Address 0x00: 54 32 30 32 37 44 41 2d 34 34 47 42 23 41 23 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 31 38 32 31 00 00
Address 0x20: 39 30 30 39 30 39 39 37 30 34 00 00 00 0f 03 07
Address 0x30: dc ff ff ff 54 32 30 32 37 44 41 2d 34 34 47 42
Address 0x40: 23 41 23 00 01 00 00 00 00 00 00 00 00 00 00 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 8c ff ff ff ff ff ff ff ff ff ff ff ff
ad0    3831 MB   UGB30SFA4000T1      SFA4000T1 00000651 Compact Flash
ad1    30533 MB UGB94BPH32H0S1-KCI  11000019592   Disk 1
usb0 (addr 1)  EHCI root hub 0      Intel      uhub0
usb0 (addr 2)  product 0x0020 32      vendor 0x8087 uhub1
DIMM 0        SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 1        SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 2        SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
DIMM 3        SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 02 740-041821 9009099706 RE-S-1800x4
Jedec Code: 0x7fb0      EEPROM Version: 0x02
P/N: 740-041821        S/N: 9009099706
Assembly ID: 0x09c0     Assembly Version: 01.02
Date: 02-23-2012       Assembly Flags: 0x00
Version: REV 02
ID: RE-S-1800x4        FRU Model Number: RE-S-1800X4-16G-S
Board Information Record:
Address 0x00: 54 32 30 32 37 44 41 2d 34 34 47 42 23 41 23 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 09 c0 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 31 38 32 31 00 00
Address 0x20: 39 30 30 39 30 39 39 37 30 36 00 00 00 17 02 07
Address 0x30: dc ff ff ff 54 32 30 32 37 44 41 2d 34 34 47 42
Address 0x40: 23 41 23 00 01 00 00 00 00 00 00 00 00 00 00 52
Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 8c ff ff ff ff ff ff ff ff ff ff ff ff
ad0    3998 MB   Virtium - TuffDrive VCF P1T0200262860208 114 Compact Flash
ad1    30533 MB UGB94ARF32H0S3-KC  UNIGEN-499551-000404 Disk 1
CB 0    REV 13 750-040257 CAAF8436 Control Board
Jedec Code: 0x7fb0      EEPROM Version: 0x02
P/N: 750-040257        S/N: CAAF8436
Assembly ID: 0x0b26     Assembly Version: 01.13
Date: 08-29-2012       Assembly Flags: 0x00
Version: REV 13        CLEI Code: PROTOXCLEI
ID: Control Board      FRU Model Number: PROTO-ASSEMBLY
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 26 01 0d 52 45 56 20 31 33 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 30 32 35 37 00 00
Address 0x20: 53 2f 4e 20 43 41 41 46 38 34 33 36 00 1d 08 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
...
SPMB 0    REV 02 711-041855 ABBV3825 PMB Board
Jedec Code: 0x7fb0      EEPROM Version: 0x01
P/N: 711-041855        S/N: ABBV3825
Assembly ID: 0x0b29     Assembly Version: 01.02

```

```

Date:          08-14-2012      Assembly Flags:    0x00
Version:       REV 02
ID: PMB Board
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 0b 29 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 34 31 38 35 35 00 00
Address 0x20: 53 2f 4e 20 41 42 42 56 33 38 32 35 00 0e 08 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
...
SFB 0          REV 05    711-044466    ABBX5682          Switch Fabric Board
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          711-044466          S/N:          ABBX5682
Assembly ID:   0x0b25          Assembly Version: 01.05
Date:         09-07-2012      Assembly Flags:    0x00
Version:       REV 05          CLEI Code:        PROTOXCLEI
ID: Switch Fabric Board      FRU Model Number:  PROTO-ASSEMBLY
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 25 01 05 52 45 56 20 30 35 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 34 34 34 36 36 00 00
Address 0x20: 53 2f 4e 20 41 42 42 58 35 36 38 32 00 07 09 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff
Address 0x70: ff ff ff c2 00 00 00 01 00 00 00 00 00 00 48 00
...
FPC 0          REV 09    750-037355    CAAF0924          MPC Type 4-2
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          750-037355          S/N:          CAAF0924
Assembly ID:   0x0b4e          Assembly Version: 01.09
Date:         05-21-2012      Assembly Flags:    0x00
Version:       REV 09          CLEI Code:        PROTOXCLEI
ID: MPC Type 4-2      FRU Model Number:  MPC4E-2CGE-8XGE
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 4e 01 09 52 45 56 20 30 39 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 33 35 35 00 00
Address 0x20: 53 2f 4e 20 43 41 41 46 30 39 32 34 00 15 05 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 4d
Address 0x50: 50 43 34 45 2d 32 43 47 45 2d 38 58 47 45 00 00
Address 0x60: 00 00 00 00 00 00 30 39 00 ff ff ff ff ff ff
Address 0x70: ff ff ff c6 ff ff ff ff ff ff ff ff ff ff ff
CPU          REV 08    711-035209    CAAB9842          HMPC PMB 2G
Jedec Code:    0x7fb0          EEPROM Version:    0x01
P/N:          711-035209          S/N:          CAAB9842
Assembly ID:   0x0b04          Assembly Version: 01.08
Date:         05-17-2012      Assembly Flags:    0x00
Version:       REV 08
ID: HMPC PMB 2G
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

```

```

I2C Hex Data:
Address 0x00: 7f b0 01 ff 0b 04 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 35 32 30 39 00 00
Address 0x20: 53 2f 4e 20 43 41 41 42 39 38 34 32 00 11 05 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
PIC 0          BUILTIN          BUILTIN          4x10GE SFPP
Jedec Code:    0x0000          EEPROM Version: 0x00
P/N:          BUILTIN          S/N:          BUILTIN
Assembly ID:   0x0a53          Assembly Version: 00.00
Date:          00-00-0000      Assembly Flags: 0x00
ID: 4x10GE SFPP
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 00 00 00 00 0a 53 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 4d 58 43 00
Address 0x20: 42 55 49 4c 54 49 4e 00 4d 58 43 00 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 ae 64 00 00 00 00 0a 52 00 00
Xcvr 0      REV 01    740-021308    19T511101656    SFP+-10G-SR
Xcvr 1      REV 01    740-031980    AMA04RU         SFP+-10G-SR
Xcvr 2      REV 01    740-031980    193363A00558    SFP+-10G-SR
Xcvr 3      REV 01    740-031980    B10M00202       SFP+-10G-SR
...
ADC 0      REV 13     750-043596    ABBX5532        Adapter Card
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N:        750-043596      S/N:          ABBX5532
Assembly ID: 0x0b3d        Assembly Version: 01.13
Date:       09-12-2012     Assembly Flags: 0x00
Version:    REV 13         CLEI Code:    IPUCBA8CAA
ID: Adapter Card          FRU Model Number: MX2000-LC-ADAPTER
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 3d 01 0d 52 45 56 20 31 33 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 33 35 39 36 00 00
Address 0x20: 53 2f 4e 20 41 42 42 58 35 35 33 32 00 0c 09 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 43 42 41 38 43 41 41 4d
Address 0x50: 58 32 30 30 30 2d 4c 43 2d 41 44 41 50 54 45 52
Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff
Address 0x70: ff ff ff 3a 00 00 00 00 00 00 00 00 00 00 00 00
...

```

### show chassis hardware models (MX2010 Router)

```

user@host > show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
FPM Board     REV 06   711-032349   ZX8744         711-032349
PSM 4         REV 0C   740-033727   VK00254        00000000000000000000000000000000
PSM 5         REV 0B   740-033727   VG00015        00000000000000000000000000000000
PSM 6         REV 0B   740-033727   VH00097        00000000000000000000000000000000
PSM 7         REV 0C   740-033727   VJ00151        00000000000000000000000000000000

```

|                  |        |            |            |                          |
|------------------|--------|------------|------------|--------------------------|
| PSM 8            | REV 0C | 740-033727 | VJ00149    | 000000000000000000000000 |
| PDM 0            | REV 0B | 740-038109 | WA00008    |                          |
| PDM 1            | REV 0B | 740-038109 | WA00014    |                          |
| Routing Engine 0 | REV 02 | 740-041821 | 9009094134 | RE-S-1800X4-16G-S        |
| Routing Engine 1 | REV 02 | 740-041821 | 9009094141 | RE-S-1800X4-16G-S        |
| CB 0             | REV 08 | 750-040257 | CAAB3491   | 750-040257               |
| CB 1             | REV 08 | 750-040257 | CAAB3489   | 750-040257               |
| SFB 0            | REV 06 | 711-032385 | ZV1828     | 711-032385               |
| SFB 1            | REV 07 | 711-032385 | ZZ2568     | 711-032385               |
| SFB 2            | REV 07 | 711-032385 | ZZ2563     | 711-032385               |
| SFB 3            | REV 07 | 711-032385 | ZZ2564     | 711-032385               |
| SFB 4            | REV 07 | 711-032385 | ZZ2580     | 711-032385               |
| SFB 5            | REV 07 | 711-032385 | ZZ2579     | 711-0323856              |
| SFB 6            | REV 07 | 711-032385 | CAAB4882   | 711-044170               |
| SFB 7            | REV 07 | 711-032385 | CAAB4898   | 711-044170               |
| FPC 0            | REV 33 | 750-028467 | CAAB1919   | MPC-3D-16XGE-SFPP        |
| FPC 1            | REV 21 | 750-033205 | ZG5027     | MX-MPC3-3D               |
| MIC 0            | REV 03 | 750-033307 | ZV6299     | MIC3-3D-10XGE-SFPP       |
| MIC 1            | REV 03 | 750-033307 | ZV6268     | MIC3-3D-10XGE-SFPP       |
| FPC 8            | REV 22 | 750-031089 | ZT9746     | MX-MPC2-3D               |
| MIC 0            | REV 26 | 750-028392 | ABBS1150   | MIC-3D-20GE-SFP          |
| MIC 1            | REV 26 | 750-028387 | ABBR9582   | MIC-3D-4XGE-XFP          |
| FPC 9            | REV 11 | 750-036284 | ZL3591     | MPCE-3D-16XGE-SFPP       |
| ADC 0            | REV 05 | 750-043596 | CAAC2073   | 750-043596               |
| ADC 1            | REV 01 | 750-043596 | ZV4117     | 750-043596               |
| ADC 8            | REV 01 | 750-043596 | ZV4107     | 750-043596               |
| ADC 9            | REV 02 | 750-043596 | ZW1555     | 750-043596               |
| Fan Tray 0       | REV 2A | 760-046960 | ACAY0015   |                          |
| Fan Tray 1       | REV 2A | 760-046960 | ACAY0019   |                          |
| Fan Tray 2       | REV 2A | 760-046960 | ACAY0020   |                          |
| Fan Tray 3       | REV 2A | 760-046960 | ACAY0021   |                          |

### show chassis hardware clei-models (MX2010 Routers)

```
user@host > show chassis hardware clei-models
```

Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number         |
|------------------|---------|-------------|------------|--------------------------|
| FPM Board        | REV 06  | 711-032349  | PROTOXCLEI | 711-032349               |
| PSM 4            | REV 0C  | 740-033727  | 0000000000 | 000000000000000000000000 |
| PSM 5            | REV 0B  | 740-033727  | 0000000000 | 000000000000000000000000 |
| PSM 6            | REV 0B  | 740-033727  | 0000000000 | 000000000000000000000000 |
| PSM 7            | REV 0C  | 740-033727  | 0000000000 | 000000000000000000000000 |
| PSM 8            | REV 0C  | 740-033727  | 0000000000 | 000000000000000000000000 |
| PDM 0            | REV 0B  | 740-038109  |            |                          |
| PDM 1            | REV 0B  | 740-038109  |            |                          |
| Routing Engine 0 | REV 02  | 740-041821  |            | RE-S-1800X4-16G-S        |
| Routing Engine 1 | REV 02  | 740-041821  |            | RE-S-1800X4-16G-S        |
| CB 0             | REV 08  | 750-040257  | PROTOXCLEI | 750-040257               |
| CB 1             | REV 08  | 750-040257  | PROTOXCLEI | 750-040257               |
| SFB 0            | REV 06  | 711-032385  | PROTOXCLEI | 711-032385               |
| SFB 1            | REV 07  | 711-032385  | PROTOXCLEI | 711-032385               |
| SFB 2            | REV 07  | 711-032385  | PROTOXCLEI | 711-032385               |
| SFB 3            | REV 07  | 711-032385  | PROTOXCLEI | 711-032385               |
| SFB 4            | REV 07  | 711-032385  | PROTOXCLEI | 711-032385               |
| SFB 5            | REV 07  | 711-032385  | PROTOXCLEI | 711-0323856              |
| SFB 6            | REV 07  | 711-032385  | PROTOXCLEI | 711-044170               |
| SFB 7            | REV 07  | 711-032385  | PROTOXCLEI | 711-044170               |
| FPC 0            | REV 33  | 750-028467  |            | MPC-3D-16XGE-SFPP        |
| FPC 1            | REV 21  | 750-033205  |            | MX-MPC3-3D               |
| MIC 0            | REV 03  | 750-033307  | PROTOXCLEI | MIC3-3D-10XGE-SFPP       |
| MIC 1            | REV 03  | 750-033307  | PROTOXCLEI | MIC3-3D-10XGE-SFPP       |

|            |        |            |            |                    |
|------------|--------|------------|------------|--------------------|
| FPC 8      | REV 22 | 750-031089 | COUIBAYBAA | MX-MPC2-3D         |
| MIC 0      | REV 26 | 750-028392 | COUIA15BAA | MIC-3D-20GE-SFP    |
| MIC 1      | REV 26 | 750-028387 | COUIA16BAA | MIC-3D-4XGE-XFP    |
| FPC 9      | REV 11 | 750-036284 | CMUIACGBAA | MPCE-3D-16XGE-SFPP |
| ADC 0      | REV 05 | 750-043596 | PROTOXCLEI | 750-043596         |
| ADC 1      | REV 01 | 750-043596 | PROTOXCLEI | 750-043596         |
| ADC 8      | REV 01 | 750-043596 | PROTOXCLEI | 750-043596         |
| ADC 9      | REV 02 | 750-043596 | PROTOXCLEI | 750-043596         |
| Fan Tray 0 | REV 2A | 760-046960 |            |                    |
| Fan Tray 1 | REV 2A | 760-046960 |            |                    |
| Fan Tray 2 | REV 2A | 760-046960 |            |                    |
| Fan Tray 3 | REV 2A | 760-046960 |            |                    |

### show chassis hardware (MX2010 Routers with MPC6E and OTN MIC)

```
user@host> show chassis hardware
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description          |
|------------------|---------|-------------|---------------|----------------------|
| Chassis          |         |             | JN11C9AFEAFK  | MX2010               |
| Midplane         | REV 35  | 750-044636  | ABAB9188      | Lower Backplane      |
| Midplane 1       | REV 02  | 711-044557  | ABAB8729      | Upper Backplane      |
| PMP              | REV 04  | 711-032426  | ACAJ2432      | Power Midplane       |
| FPM Board        | REV 09  | 760-044634  | ABCA4314      | Front Panel Display  |
| PSM 0            | REV 01  | 740-050037  | 1EDB321015C   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 1            | REV 01  | 740-050037  | 1EDB321015J   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 2            | REV 01  | 740-050037  | 1EDB32000K8   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 3            | REV 01  | 740-050037  | 1EDB32101JW   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 4            | REV 01  | 740-050037  | 1EDB321015G   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 5            | REV 01  | 740-050037  | 1EDB32101HH   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 6            | REV 01  | 740-050037  | 1EDB32101HD   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 7            | REV 01  | 740-050037  | 1EDB321015F   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PSM 8            | REV 01  | 740-050037  | 1EDB321015B   | DC 52V Power Supply  |
| Module           |         |             |               |                      |
| PDM 0            | REV 03  | 740-045234  | 1EFA3220433   | DC Power Dist Module |
| PDM 1            | REV 03  | 740-045234  | 1EFA3220425   | DC Power Dist Module |
| Routing Engine 0 | REV 02  | 740-041821  | 9009115685    | RE-S-1800x4          |
| Routing Engine 1 | REV 02  | 740-041821  | 9009099711    | RE-S-1800x4          |
| CB 0             | REV 23  | 750-040257  | CABE8395      | Control Board        |
| CB 1             | REV 12  | 750-040257  | CAAD9499      | Control Board        |
| SPMB 0           | REV 02  | 711-041855  | ABCG8426      | PMB Board            |
| SPMB 1           | REV 02  | 711-041855  | ABBS1481      | PMB Board            |
| SFB 0            | REV 06  | 711-044466  | ABCD5013      | Switch Fabric Board  |
| SFB 1            | REV 06  | 711-044466  | ABCD5160      | Switch Fabric Board  |
| SFB 2            | REV 06  | 711-044466  | ABCD5175      | Switch Fabric Board  |
| SFB 3            | REV 06  | 711-044466  | ABCD4938      | Switch Fabric Board  |
| SFB 4            | REV 06  | 711-044466  | ABCD4944      | Switch Fabric Board  |
| SFB 5            | REV 06  | 711-044466  | ABCD4968      | Switch Fabric Board  |
| SFB 6            | REV 06  | 711-044466  | ABCD5267      | Switch Fabric Board  |
| SFB 7            | REV 06  | 711-044466  | ABCD4997      | Switch Fabric Board  |
| FPC 0            | REV 59  | 750-044130  | ABCT7676      | MPC6E 3D             |
| CPU              | REV 10  | 711-045719  | ABCK8527      | RMPK PMB             |
| XLM 0            | REV 13  | 711-046638  | ABCT7810      | MPC6E XL             |
| XLM 1            | REV 13  | 711-046638  | ABCT7811      | MPC6E XL             |

|            |             |            |                |                        |
|------------|-------------|------------|----------------|------------------------|
| FPC 2      | REV 27      | 750-033205 | ZL6014         | MPCE Type 3 3D         |
| CPU        | REV 07      | 711-035209 | ZK9068         | HMPD PMB 2G            |
| MIC 0      | REV 14      | 750-033196 | CAAW9214       | 1X100GE CXP            |
| PIC 0      |             | BUILTIN    | BUILTIN        | 1X100GE CXP            |
| Xcvr 0     | REV 01      | 740-046563 | XC49FC030      | CFP2-100G-SR10         |
| MIC 1      | REV 18      | 750-033199 | CAAC3231       | 1X100GE CFP            |
| PIC 2      |             | BUILTIN    | BUILTIN        | 1X100GE CFP            |
| FPC 3      | REV 59      | 750-044130 | ABCT7682       | MPC6E 3D               |
| CPU        | REV 10      | 711-045719 | ABCK8531       | RMPD PMB               |
| XLM 0      | REV 13      | 711-046638 | ABCT7818       | MPC6E XL               |
| XLM 1      | REV 13      | 711-046638 | ABCT7819       | MPC6E XL               |
| FPC 4      | REV 33      | 750-044130 | ABBY9278       | MPC6E 3D               |
| CPU        | REV 09      | 711-045719 | ABBY8677       | RMPD PMB               |
| XLM 0      | REV 06.2.00 | 711-046638 | ABBY8844       | MPC6E XL               |
| XLM 1      | REV 06.2.00 | 711-046638 | ABBY8830       | MPC6E XL               |
| FPC 5      | REV 59      | 750-044130 | ABCT7675       | MPC6E 3D               |
| CPU        | REV 10      | 711-045719 | ABCK8526       | RMPD PMB               |
| XLM 0      | REV 13      | 711-046638 | ABCT7808       | MPC6E XL               |
| XLM 1      | REV 13      | 711-046638 | ABCT7809       | MPC6E XL               |
| FPC 6      | REV 30      | 750-028467 | ZM4986         | MPC 3D 16x 10GE        |
| CPU        | REV 10      | 711-029089 | ZP6541         | AMPD PMB               |
| PIC 0      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-021308 | AQ43GAC        | SFP+-10G-SR            |
| PIC 1      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-031980 | ALMOA6D        | SFP+-10G-SR            |
| Xcvr 1     | REV 01      | 740-031980 | AQFORB3        | SFP+-10G-SR            |
| Xcvr 2     | REV 01      | 740-031980 | 153363A00333   | SFP+-10G-SR            |
| Xcvr 3     | REV 01      | 740-021308 | AN10KYE        | SFP+-10G-SR            |
| PIC 2      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-021308 | APK04YM        | SFP+-10G-SR            |
| PIC 3      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-031980 | AQFOH44        | SFP+-10G-SR            |
| FPC 8      | REV 38      | 750-031090 | CABF7313       | MPC Type 2 3D EQ       |
| CPU        | REV 08      | 711-030884 | CABE6727       | MPC PMB 2G             |
| MIC 0      | REV 18      | 750-028380 | YK8253         | 3D 2x 10GE XFP         |
| PIC 0      |             | BUILTIN    | BUILTIN        | 1x 10GE XFP            |
| Xcvr 0     | REV 03      | 740-014289 | AD1148M00TP    | XFP-10G-SR             |
| PIC 1      |             | BUILTIN    | BUILTIN        | 1x 10GE XFP            |
| QXM 0      | REV 06      | 711-028408 | CABC5614       | MPC QXM                |
| QXM 1      | REV 06      | 711-028408 | CABC5550       | MPC QXM                |
| FPC 9      | REV 39      | 750-044130 | ABCK1652       | MPC6E 3D               |
| CPU        | REV 09      | 711-045719 | ABCK1655       | RMPD PMB               |
| MIC 0      | REV 09      | 750-049457 | ABCP1230       | 2X100GE CFP2 OTN       |
| PIC 0      |             | BUILTIN    | BUILTIN        | 2X100GE CFP2 OTN       |
| Xcvr 0     |             | NON-JNPR   | 37300222WP0002 | CFP2-100G-LR4-D        |
| Xcvr 1     |             | NON-JNPR   | FD46F001Y      | CFP2-100G-SR10         |
| MIC 1      | REV 07      | 750-049457 | ABCV6662       | 2X100GE CFP2 OTN       |
| PIC 1      |             | BUILTIN    | BUILTIN        | 2X100GE CFP2 OTN       |
| Xcvr 0     |             | NON-JNPR   | UQD0014        | CFP2-100G-LR4-D        |
| Xcvr 1     |             | NON-JNPR   | J13J68335      | CFP2-100G-LR4-D        |
| XLM 0      | REV 07.2.00 | 711-046638 | ABCK5491       | MPC6E XL               |
| XLM 1      | REV 07.2.00 | 711-046638 | ABCK5475       | MPC6E XL               |
| ADC 1      | REV 17      | 750-043596 | ABCG9023       | Adapter Card           |
| ADC 2      | REV 01      | 750-043596 | ZV4079         | Adapter Card           |
| ADC 6      | REV 17      | 750-043596 | ABCG8866       | Adapter Card           |
| ADC 8      | REV 17      | 750-043596 | ABCA8993       | Adapter Card           |
| Fan Tray 0 | REV 06      | 760-046960 | ACAY0354       | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 06      | 760-046960 | ACAY0831       | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 06      | 760-046960 | ACAY0892       | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 06      | 760-046960 | ACAY0839       | 172mm FanTray - 6 Fans |

## show chassis hardware detail (MX2010 Routers with MPC6E and OTN MIC)

```

user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN11C9AFEAFK  MX2010
Midplane      REV 35   750-044636   ABAB9188      Lower Backplane
Midplane 1    REV 02   711-044557   ABAB8729      Upper Backplane
PMP           REV 04   711-032426   ACAJ2432      Power Midplane
FPM Board     REV 09   760-044634   ABCA4314      Front Panel Display
PSM 0         REV 01   740-050037   1EDB321015C   DC 52V Power Supply
Module
PSM 1         REV 01   740-050037   1EDB321015J   DC 52V Power Supply
Module
PSM 2         REV 01   740-050037   1EDB32000K8   DC 52V Power Supply
Module
PSM 3         REV 01   740-050037   1EDB32101JW   DC 52V Power Supply
Module
PSM 4         REV 01   740-050037   1EDB321015G   DC 52V Power Supply
Module
PSM 5         REV 01   740-050037   1EDB32101HH   DC 52V Power Supply
Module
PSM 6         REV 01   740-050037   1EDB32101HD   DC 52V Power Supply
Module
PSM 7         REV 01   740-050037   1EDB321015F   DC 52V Power Supply
Module
PSM 8         REV 01   740-050037   1EDB321015B   DC 52V Power Supply
Module
PDM 0         REV 03   740-045234   1EFA3220433   DC Power Dist Module
PDM 1         REV 03   740-045234   1EFA3220425   DC Power Dist Module
Routing Engine 0 REV 02   740-041821   9009115685     RE-S-1800x4
  ad0  3998 MB  Virtium - TuffDrive VCF P1T0200274310822 191 Compact Flash
  ad1  30533 MB UGB94BPH32H0S1-KCI  11000043190      Disk 1
  usb0 (addr 1) EHCI root hub 0      Intel            uhub0
  usb0 (addr 2) product 0x0020 32 vendor 0x8087      uhub1
  DIMM 0      VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
  DIMM 1      VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
  DIMM 2      VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
  DIMM 3      VL31B5263F-F8SD DIE REV-0 PCB REV-0    MFR ID-ce80
Routing Engine 1 REV 02   740-041821   9009099711     RE-S-1800x4
  ad0  3998 MB  Virtium - TuffDrive VCF P1T0200262860208 30 Compact Flash
  ad1  30533 MB UGB94ARF32H0S3-KC  UNIGEN-499551-000146 Disk 1
CB 0          REV 23   750-040257   CABE8395      Control Board
CB 1          REV 12   750-040257   CAAD9499      Control Board
SPMB 0        REV 02   711-041855   ABCG8426      PMB Board
SPMB 1        REV 02   711-041855   ABBS1481      PMB Board
SFB 0         REV 06   711-044466   ABCD5013      Switch Fabric Board
SFB 1         REV 06   711-044466   ABCD5160      Switch Fabric Board
SFB 2         REV 06   711-044466   ABCD5175      Switch Fabric Board
SFB 3         REV 06   711-044466   ABCD4938      Switch Fabric Board
SFB 4         REV 06   711-044466   ABCD4944      Switch Fabric Board
SFB 5         REV 06   711-044466   ABCD4968      Switch Fabric Board
SFB 6         REV 06   711-044466   ABCD5267      Switch Fabric Board
SFB 7         REV 06   711-044466   ABCD4997      Switch Fabric Board
FPC 0         REV 59   750-044130   ABCT7676      MPC6E 3D
  CPU        REV 10   711-045719   ABCK8527      RMPC PMB
  XLM 0       REV 13   711-046638   ABCT7810      MPC6E XL
  XLM 1       REV 13   711-046638   ABCT7811      MPC6E XL
FPC 2         REV 27   750-033205   ZL6014        MPCE Type 3 3D
  CPU        REV 07   711-035209   ZK9068        HMPCE PMB 2G
  MIC 0       REV 14   750-033196   CAAW9214      1X100GE CX

```

|            |             |            |                |                        |
|------------|-------------|------------|----------------|------------------------|
| PIC 0      |             | BUILTIN    | BUILTIN        | 1X100GE CXP            |
| Xcvr 0     | REV 01      | 740-046563 | XC49FC030      | CFP2-100G-SR10         |
| MIC 1      | REV 18      | 750-033199 | CAAC3231       | 1X100GE CFP            |
| PIC 2      |             | BUILTIN    | BUILTIN        | 1X100GE CFP            |
| FPC 3      | REV 59      | 750-044130 | ABCT7682       | MPC6E 3D               |
| CPU        | REV 10      | 711-045719 | ABCK8531       | RMPD PMB               |
| XLM 0      | REV 13      | 711-046638 | ABCT7818       | MPC6E XL               |
| XLM 1      | REV 13      | 711-046638 | ABCT7819       | MPC6E XL               |
| FPC 4      | REV 33      | 750-044130 | ABBY9278       | MPC6E 3D               |
| CPU        | REV 09      | 711-045719 | ABBY8677       | RMPD PMB               |
| XLM 0      | REV 06.2.00 | 711-046638 | ABBY8844       | MPC6E XL               |
| XLM 1      | REV 06.2.00 | 711-046638 | ABBY8830       | MPC6E XL               |
| FPC 5      | REV 59      | 750-044130 | ABCT7675       | MPC6E 3D               |
| CPU        | REV 10      | 711-045719 | ABCK8526       | RMPD PMB               |
| XLM 0      | REV 13      | 711-046638 | ABCT7808       | MPC6E XL               |
| XLM 1      | REV 13      | 711-046638 | ABCT7809       | MPC6E XL               |
| FPC 6      | REV 30      | 750-028467 | ZM4986         | MPC 3D 16x 10GE        |
| CPU        | REV 10      | 711-029089 | ZP6541         | AMPD PMB               |
| PIC 0      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-021308 | AQ43GAC        | SFP+-10G-SR            |
| PIC 1      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-031980 | ALMOA6D        | SFP+-10G-SR            |
| Xcvr 1     | REV 01      | 740-031980 | AQFORB3        | SFP+-10G-SR            |
| Xcvr 2     | REV 01      | 740-031980 | 153363A00333   | SFP+-10G-SR            |
| Xcvr 3     | REV 01      | 740-021308 | AN10KYE        | SFP+-10G-SR            |
| PIC 2      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-021308 | APK04YM        | SFP+-10G-SR            |
| PIC 3      |             | BUILTIN    | BUILTIN        | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01      | 740-031980 | AQFOH44        | SFP+-10G-SR            |
| FPC 8      | REV 38      | 750-031090 | CABF7313       | MPC Type 2 3D EQ       |
| CPU        | REV 08      | 711-030884 | CABE6727       | MPC PMB 2G             |
| MIC 0      | REV 18      | 750-028380 | YK8253         | 3D 2x 10GE XFP         |
| PIC 0      |             | BUILTIN    | BUILTIN        | 1x 10GE XFP            |
| Xcvr 0     | REV 03      | 740-014289 | AD1148M00TP    | XFP-10G-SR             |
| PIC 1      |             | BUILTIN    | BUILTIN        | 1x 10GE XFP            |
| QXM 0      | REV 06      | 711-028408 | CABC5614       | MPC QXM                |
| QXM 1      | REV 06      | 711-028408 | CABC5550       | MPC QXM                |
| FPC 9      | REV 39      | 750-044130 | ABCK1652       | MPC6E 3D               |
| CPU        | REV 09      | 711-045719 | ABCK1655       | RMPD PMB               |
| MIC 0      | REV 09      | 750-049457 | ABCP1230       | 2X100GE CFP2 OTN       |
| PIC 0      |             | BUILTIN    | BUILTIN        | 2X100GE CFP2 OTN       |
| Xcvr 0     |             | NON-JNPR   | 37300222WP0002 | CFP2-100G-LR4-D        |
| Xcvr 1     |             | NON-JNPR   | FD46F001Y      | CFP2-100G-SR10         |
| MIC 1      | REV 07      | 750-049457 | ABCV6662       | 2X100GE CFP2 OTN       |
| PIC 1      |             | BUILTIN    | BUILTIN        | 2X100GE CFP2 OTN       |
| Xcvr 0     |             | NON-JNPR   | UQD0014        | CFP2-100G-LR4-D        |
| Xcvr 1     |             | NON-JNPR   | J13J68335      | CFP2-100G-LR4-D        |
| XLM 0      | REV 07.2.00 | 711-046638 | ABCK5491       | MPC6E XL               |
| XLM 1      | REV 07.2.00 | 711-046638 | ABCK5475       | MPC6E XL               |
| ADC 1      | REV 17      | 750-043596 | ABCG9023       | Adapter Card           |
| ADC 2      | REV 01      | 750-043596 | ZV4079         | Adapter Card           |
| ADC 6      | REV 17      | 750-043596 | ABCG8866       | Adapter Card           |
| ADC 8      | REV 17      | 750-043596 | ABCA8993       | Adapter Card           |
| Fan Tray 0 | REV 06      | 760-046960 | ACAY0354       | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 06      | 760-046960 | ACAY0831       | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 06      | 760-046960 | ACAY0892       | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 06      | 760-046960 | ACAY0839       | 172mm FanTray - 6 Fans |

## show chassis hardware extensive (MX2010 Routers with MPC6E and OTN MIC)

user@host&gt; show chassis hardware extensive



## Hardware inventory:

| Item                                                          | Version         | Part number       | Serial number    | Description     |
|---------------------------------------------------------------|-----------------|-------------------|------------------|-----------------|
| Chassis                                                       |                 |                   | JN11C9AFEAFK     | MX2010          |
| Jedec Code:                                                   | 0x7fb0          | EEPROM Version:   | 0x02             |                 |
|                                                               |                 | S/N:              | JN11C9AFEAFK     |                 |
| Assembly ID:                                                  | 0x0557          | Assembly Version: | 00.00            |                 |
| Date:                                                         | 00-00-0000      | Assembly Flags:   | 0x00             |                 |
| ID:                                                           | MX2010          |                   |                  |                 |
| Board Information Record:                                     |                 |                   |                  |                 |
| Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| I2C Hex Data:                                                 |                 |                   |                  |                 |
| Address 0x00: 7f b0 02 ff 05 57 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x20: 4a 4e 31 31 43 39 41 46 45 41 46 4b 00 00 00 00 |                 |                   |                  |                 |
| Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Midplane                                                      | REV 35          | 750-044636        | ABAB9188         | Lower Backplane |
| Jedec Code:                                                   | 0x7fb0          | EEPROM Version:   | 0x02             |                 |
| P/N:                                                          | 750-044636      | S/N:              | ABAB9188         |                 |
| Assembly ID:                                                  | 0x0b66          | Assembly Version: | 01.35            |                 |
| Date:                                                         | 06-21-2013      | Assembly Flags:   | 0x00             |                 |
| Version:                                                      | REV 35          | CLEI Code:        | IPMU810ARA       |                 |
| ID:                                                           | Lower Backplane | FRU Model Number: | CHAS-BP-MX2010-S |                 |
| Board Information Record:                                     |                 |                   |                  |                 |
| Address 0x00: ad 01 08 00 3c 8a b0 38 68 00 ff ff ff ff ff ff |                 |                   |                  |                 |
| I2C Hex Data:                                                 |                 |                   |                  |                 |
| Address 0x00: 7f b0 02 ff 0b 66 01 23 52 45 56 20 33 35 00 00 |                 |                   |                  |                 |
| Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 36 33 36 00 00 |                 |                   |                  |                 |
| Address 0x20: 53 2f 4e 20 41 42 41 42 39 31 38 38 00 15 06 07 |                 |                   |                  |                 |
| Address 0x30: dd ff ff ff ad 01 08 00 3c 8a b0 38 68 00 ff ff |                 |                   |                  |                 |
| Address 0x40: ff ff ff ff 01 49 50 4d 55 38 31 30 41 52 41 43 |                 |                   |                  |                 |
| Address 0x50: 48 41 53 2d 42 50 2d 4d 58 32 30 31 30 2d 53 00 |                 |                   |                  |                 |
| Address 0x60: 00 00 00 00 00 00 30 36 00 ff ff ff ff ff ff ff |                 |                   |                  |                 |
| Address 0x70: ff ff ff f8 ff ff ff ff ff ff ff ff ff ff ff ff |                 |                   |                  |                 |
| Midplane 1                                                    | REV 02          | 711-044557        | ABAB8729         | Upper Backplane |
| Jedec Code:                                                   | 0x7fb0          | EEPROM Version:   | 0x01             |                 |
| P/N:                                                          | 711-044557      | S/N:              | ABAB8729         |                 |
| Assembly ID:                                                  | 0x0b65          | Assembly Version: | 01.02            |                 |
| Date:                                                         | 03-21-2013      | Assembly Flags:   | 0x00             |                 |
| Version:                                                      | REV 02          |                   |                  |                 |
| ID:                                                           | Upper Backplane |                   |                  |                 |
| Board Information Record:                                     |                 |                   |                  |                 |
| Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |                 |                   |                  |                 |
| I2C Hex Data:                                                 |                 |                   |                  |                 |
| Address 0x00: 7f b0 01 ff 0b 65 01 02 52 45 56 20 30 32 00 00 |                 |                   |                  |                 |
| Address 0x10: 00 00 00 00 37 31 31 2d 30 34 34 35 35 37 00 00 |                 |                   |                  |                 |
| Address 0x20: 53 2f 4e 20 41 42 41 42 38 37 32 39 00 15 03 07 |                 |                   |                  |                 |
| Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |                 |                   |                  |                 |
| Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |                 |                   |                  |                 |
| Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff |                 |                   |                  |                 |
| Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |                 |                   |                  |                 |
| PMP                                                           | REV 04          | 711-032426        | ACAJ2432         | Power Midplane  |
| Jedec Code:                                                   | 0x7fb0          | EEPROM Version:   | 0x01             |                 |
| P/N:                                                          | 711-032426      | S/N:              | ACAJ2432         |                 |
| Assembly ID:                                                  | 0x045d          | Assembly Version: | 01.04            |                 |
| Date:                                                         | 03-28-2013      | Assembly Flags:   | 0x00             |                 |
| Version:                                                      | REV 04          |                   |                  |                 |

```

ID: Power Midplane
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 5d 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 34 32 36 00 00
  Address 0x20: 53 2f 4e 20 41 43 41 4a 32 34 33 32 00 1c 03 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Board          REV 09    760-044634    ABCA4314          Front Panel Display
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          760-044634      S/N:              ABCA4314
Assembly ID:   0x0b64          Assembly Version:  01.09
Date:          03-28-2013      Assembly Flags:    0x00
Version:       REV 09          CLEI Code:         IPMYA4EJRA
ID: Front Panel Display      FRU Model Number:  MX2010-CRAFT-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 64 01 09 52 45 56 20 30 39 00 00
  Address 0x10: 00 00 00 00 37 36 30 2d 30 34 34 36 33 34 00 00
  Address 0x20: 53 2f 4e 20 41 42 43 41 34 33 31 34 00 1c 03 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 4d 59 41 34 45 4a 52 41 4d
  Address 0x50: 58 32 30 31 30 2d 43 52 41 46 54 2d 53 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 93 ff ff ff ff ff ff ff ff ff ff ff ff
PSM 0              REV 01    740-050037    1EDB321015C      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          740-050037      S/N:              1EDB321015C
Assembly ID:   0x0478          Assembly Version:  01.01
Date:          05-28-2013      Assembly Flags:    0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
  Address 0x20: 31 45 44 42 33 32 31 30 31 35 43 00 00 1c 05 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
  Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
  Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 1              REV 01    740-050037    1EDB321015J      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          740-050037      S/N:              1EDB321015J
Assembly ID:   0x0478          Assembly Version:  01.01
Date:          05-28-2013      Assembly Flags:    0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00

```

```

Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 35 4a 00 00 1c 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 2          REV 01  740-050037  1EDB32000K8      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:            1EDB32000K8
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-23-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 30 30 30 4b 38 00 00 17 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 3          REV 01  740-050037  1EDB32101JW      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:            1EDB32101JW
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-30-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 4a 57 00 00 1e 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 4          REV 01  740-050037  1EDB321015G      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:            1EDB321015G
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-28-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 35 47 00 00 1c 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d

```

```

Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 5          REV 01   740-050037   1EDB32101HH   DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB32101HH
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-30-2013      Assembly Flags:   0x00
Version:       REV 01          CLEI Code:        IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 48 48 00 00 1e 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 6          REV 01   740-050037   1EDB32101HD   DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB32101HD
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-30-2013      Assembly Flags:   0x00
Version:       REV 01          CLEI Code:        IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 48 44 00 00 1e 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 7          REV 01   740-050037   1EDB321015F   DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB321015F
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-28-2013      Assembly Flags:   0x00
Version:       REV 01          CLEI Code:        IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 35 46 00 00 1c 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 8          REV 01   740-050037   1EDB321015B   DC 52V Power Supply

```

```

Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-050037          S/N: 1EDB321015B
Assembly ID: 0x0478        Assembly Version: 01.01
Date: 05-28-2013          Assembly Flags: 0x00
Version: REV 01           CLEI Code: IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 31 30 31 35 42 00 00 1c 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PDM 0          REV 03 740-045234 1EFA3220433 DC Power Dist Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-045234          S/N: 1EFA3220433
Assembly ID: 0x047b        Assembly Version: 01.03
Date: 05-30-2013          Assembly Flags: 0x00
Version: REV 03           CLEI Code: IPUPAJSKAA
ID: DC Power Dist Module  FRU Model Number: MX2000-PDM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 7b 01 03 52 45 56 20 30 33 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 32 33 34 00 00
Address 0x20: 31 45 46 41 33 32 32 30 34 33 33 00 00 1e 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4a 53 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 44 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 33 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 1d 00 00 00 00 00 00 00 00 00 00 00 00
PDM 1          REV 03 740-045234 1EFA3220425 DC Power Dist Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-045234          S/N: 1EFA3220425
Assembly ID: 0x047b        Assembly Version: 01.03
Date: 05-30-2013          Assembly Flags: 0x00
Version: REV 03           CLEI Code: IPUPAJSKAA
ID: DC Power Dist Module  FRU Model Number: MX2000-PDM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
..

```

### show chassis hardware (MX2020 Router)

```

user@host > show chassis hardware
Hardware inventory:

```

| Item       | Version | Part number | Serial number | Description          |
|------------|---------|-------------|---------------|----------------------|
| Chassis    |         |             | JN11E2227AFJ  | MX2020               |
| Midplane   | REV 27  | 750-040240  | ABAB9384      | Lower Power Midplane |
| Midplane 1 | REV 04  | 711-032386  | ABAB9386      | Upper Backplane      |
| PMP 1      | REV 05  | 711-032428  | ACAJ1579      | Upper Power Midplane |
| PMP 0      | REV 04  | 711-032426  | ACAJ1524      | Lower Power Midplane |
| FPM Board  | REV 06  | 760-040242  | ABBT8837      | Front Panel Display  |
| PSM 0      | REV 01  | 740-045050  | 1E022240056   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 1      | REV 01  | 740-045050  | 1E022240054   | DC 52V Power Supply  |

|                  |        |            |             |                      |
|------------------|--------|------------|-------------|----------------------|
| Module           |        |            |             |                      |
| PSM 2            | REV 01 | 740-045050 | 1E02224005H | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 3            | REV 01 | 740-045050 | 1E022240053 | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 4            | REV 01 | 740-045050 | 1E02224004K | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 7            | REV 01 | 740-045050 | 1E02224006W | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 8            | REV 01 | 740-045050 | 1E022240062 | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 9            | REV 01 | 740-045050 | 1E02224005B | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 10           | REV 01 | 740-045050 | 1E02224005A | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 11           | REV 01 | 740-045050 | 1E022240052 | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 12           | REV 01 | 740-045050 | 1E022240051 | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 13           | REV 01 | 740-045050 | 1E022240058 | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 14           | REV 01 | 740-045050 | 1E02224004L | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 15           | REV 01 | 740-045050 | 1E02224005M | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 16           | REV 01 | 740-045050 | 1E02224006S | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PSM 17           | REV 01 | 740-045050 | 1E02224005Z | DC 52V Power Supply  |
| Module           |        |            |             |                      |
| PDM 0            | REV 01 | 740-045234 | 1E012150033 | DC Power Dist Module |
| PDM 1            | REV 01 | 740-045234 | 1E012150027 | DC Power Dist Module |
| PDM 2            | REV 01 | 740-045234 | 1E012150028 | DC Power Dist Module |
| PDM 3            | REV 01 | 740-045234 | 1E012150045 | DC Power Dist Module |
| Routing Engine 0 | REV 02 | 740-041821 | 9009089704  | RE-S-1800x4          |
| Routing Engine 1 | REV 02 | 740-041821 | 9009094138  | RE-S-1800x4          |
| CB 0             | REV 14 | 750-040257 | CAAF8430    | Control Board        |
| CB 1             | REV 08 | 750-040257 | CAAB3482    | Control Board        |
| SPMB 0           | REV 01 | 711-041855 | ZS2290      | PMB Board            |
| SPMB 1           | REV 02 | 711-041855 | CAAA6141    | PMB Board            |
| SFB 0            | REV 03 | 711-044466 | ABBV6789    | Switch Fabric Board  |
| SFB 1            | REV 05 | 711-044466 | ABBX5666    | Switch Fabric Board  |
| SFB 2            | REV 05 | 711-044466 | ABBX5678    | Switch Fabric Board  |
| SFB 3            | REV 05 | 711-044466 | ABBX5687    | Switch Fabric Board  |
| SFB 4            | REV 05 | 711-044466 | ABBX5609    | Switch Fabric Board  |
| SFB 5            | REV 05 | 711-044466 | ABBX5675    | Switch Fabric Board  |
| SFB 6            | REV 03 | 711-044466 | ABBV6805    | Switch Fabric Board  |
| SFB 7            | REV 05 | 711-044466 | ABBX5701    | Switch Fabric Board  |
| FPC 0            | REV 30 | 750-028467 | ABBN0284    | MPC 3D 16x 10GE      |
| CPU              | REV 10 | 711-029089 | ABBN0507    | AMPC PMB             |
| PIC 0            |        | BUILTIN    | BUILTIN     | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658 | B11E00990   | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658 | B11E04357   | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658 | B11F01327   | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658 | B11E04375   | SFP+-10G-USR         |
| PIC 1            |        | BUILTIN    | BUILTIN     | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658 | B11E02760   | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658 | B11E02904   | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658 | B11E03963   | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658 | B11E00756   | SFP+-10G-USR         |
| PIC 2            |        | BUILTIN    | BUILTIN     | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658 | B11E04418   | SFP+-10G-USR         |

|        |        |            |           |                   |
|--------|--------|------------|-----------|-------------------|
| Xcvr 1 | REV 01 | 740-030658 | B11E01077 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01128 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01253 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E01140 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01626 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01075 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01177 | SFP+-10G-USR      |
| FPC 1  | REV 30 | 750-028467 | ABBN0208  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBJ1084  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04745 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01570 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E04388 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01439 | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04739 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01869 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01675 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01901 | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01346 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01288 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01824 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E04312 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02811 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E03847 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01495 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01265 | SFP+-10G-USR      |
| FPC 2  | REV 30 | 750-028467 | ZM5111    | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ZP6607    | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LJA   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MFZ   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKL   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KF4   | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80FBJ   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MM2   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LJV   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NXV   | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N1H   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLS   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80FL5   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL9   | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NG2   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80KDU   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80MG1   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80MM0   | SFP+-10G-SR       |
| FPC 3  | REV 30 | 750-028467 | ABBN0302  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0495  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01581 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01176 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01251 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02752 | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00786 | SFP+-10G-USR      |

|        |        |            |           |                   |
|--------|--------|------------|-----------|-------------------|
| Xcvr 1 | REV 01 | 740-030658 | B11E01020 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01023 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02819 | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02812 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11D04437 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01279 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01333 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00978 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01018 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01784 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-031980 | AK80NKP   | SFP+-10G-SR       |
| FPC 4  | REV 30 | 750-028467 | ABBN0308  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABB11095  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04305 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01147 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01195 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01743 | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01892 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02880 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00725 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01057 | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02816 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11C04501 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E02764 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00789 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01250 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02847 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00787 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E03803 | SFP+-10G-USR      |
| FPC 5  | REV 30 | 750-028467 | ABBN0316  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABB11082  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00523 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01848 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01865 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00540 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00422 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00428 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K00423 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01855 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K01847 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00526 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K00529 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00525 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00425 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00530 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01851 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00528 | SFP+-10G-SR       |
| FPC 6  | REV 32 | 750-028467 | ABBN6832  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN6534  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MB4   | SFP+-10G-SR       |



|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 1 | REV 01 | 740-031980 | AK80FQ6      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N1F      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLQ      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80KDR      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80FGJ      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N5G      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KD8      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LET      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80N1X      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NRF      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL2      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N3D      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MRB      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LEQ      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LER      | SFP+-10G-SR       |
| FPC 7  | REV 32 | 750-028467 | ABBN6811     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7288     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NK8      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80LJG      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LBU      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N21      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEU      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLM      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NL6      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LES      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEN      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80ME0      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LMG      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80MM1      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MG7      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80KF9      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NRQ      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLE      | SFP+-10G-SR       |
| FPC 8  | REV 23 | 750-028467 | YN2977       | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | YP1856       | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00875 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00851 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00772 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00882 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00735 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00169 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00726 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00077 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00168 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00676 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00732 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00091 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00725 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00642 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00871 | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 3 | REV 01 | 740-031980 | 183363A00853 | SFP+-10G-SR       |
| FPC 9  | REV 32 | 750-028467 | ABBN6798     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6556     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 9ZDZ06A00055 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00239 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-021308 | AD0915E003K  | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | AD0915E003A  | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MRC      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NL5      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKN      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N3U      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N1T      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AJ808DJ      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NG4      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80FND      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80FKQ      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLT      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKR      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LKM      | SFP+-10G-SR       |
| FPC 10 | REV 32 | 750-028467 | ABBN6813     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6542     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NA3      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLF      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80MRH      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KE4      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00030 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80L9H      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80ME8      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLR      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NG1      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MCA      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LFC      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LEM      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N9X      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80LAC      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LF2      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N8T      | SFP+-10G-SR       |
| FPC 11 | REV 30 | 750-028467 | ABBN0281     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0526     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01326    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E03973    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00950    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00674    | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00775    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E04461    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01074    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02821    | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04501    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00757    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01623    | SFP+-10G-USR      |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 3 | REV 01 | 740-030658 | B11E01022    | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04359    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02751    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E02736    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01178    | SFP+-10G-USR      |
| FPC 12 | REV 32 | 750-028467 | ABBN6796     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7259     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K01856    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01853    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01863    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02863 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02668 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02881 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01671 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02627 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02725 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02692 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02730 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03081 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02736 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02568 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02747 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02579 | SFP+-10G-SR       |
| FPC 13 | REV 30 | 750-028467 | ABBN0270     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBJ0966     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NL1      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NXW      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KD2      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80FMD      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NKQ      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MGH      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N38      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL7      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEL      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NKD      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KCY      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LHK      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80M5J      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MBE      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NLG      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LFH      | SFP+-10G-SR       |
| FPC 14 | REV 32 | 750-028467 | ABBN6790     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6515     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LZM      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MCC      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KCM      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KE0      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021310 | C10F99155    | SFP+-10G-LRM      |
| Xcvr 1 | REV 01 | 740-021310 | C10F99049    | SFP+-10G-LRM      |
| Xcvr 2 | REV 01 | 740-021310 | C10F99128    | SFP+-10G-LRM      |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 3 | REV 01 | 740-021310 | C10F99169    | SFP+-10G-LRM      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LF3      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02597 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A03060 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03057 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEX      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80FEU      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80FNM      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | AJQQQ5G      | SFP+-10G-SR       |
| FPC 15 | REV 32 | 750-028467 | ABBN6791     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7289     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00424    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01849    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01862    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01852    | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00427    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00430    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01854    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00426    | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00429    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01864    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01850    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00522    | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E01144    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00985    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00796    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-031980 | B11K01866    | SFP+-10G-SR       |
| FPC 16 | REV 30 | 750-028467 | ABBM4592     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0465     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01435    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01052    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01328    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01254    | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02738    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02881    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01624    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00889    | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02883    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00681    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E04306    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02813    | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01801    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02753    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01156    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E04324    | SFP+-10G-USR      |
| FPC 17 | REV 32 | 750-028467 | ABBN6810     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7237     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02638 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02082 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01674 | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 3 | REV 01 | 740-031980 | 163363A03058 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A03048 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02729 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02566 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02567 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02878 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02739 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01959 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02660 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02731 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02588 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02673 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02654 | SFP+-10G-SR       |
| FPC 18 | REV 30 | 750-028467 | ABBM4739     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0487     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02569 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02886 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A03082 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 133363A00297 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02726 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A03050 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02884 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03076 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02581 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02873 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02582 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03083 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031981 | UL70BU6      | SFP+-10G-LR       |
| Xcvr 1 | REV 01 | 740-031981 | UL50QC6      | SFP+-10G-LR       |
| Xcvr 2 | REV 01 | 740-031981 | UL708N6      | SFP+-10G-LR       |
| Xcvr 3 | REV 01 | 740-031981 | UL603KK      | SFP+-10G-LR       |
| FPC 19 | REV 32 | 750-028467 | ABBN6827     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6508     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A01688 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A01724 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01773 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02593 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A03061 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A03056 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02669 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03070 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02572 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02697 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02585 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03052 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02591 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02649 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02577 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02698 | SFP+-10G-SR       |
| ADC 0  | REV 13 | 750-043596 | ABBX5561     | Adapter Card      |

|            |        |            |          |                        |
|------------|--------|------------|----------|------------------------|
| ADC 1      | REV 13 | 750-043596 | ABBX5546 | Adapter Card           |
| ADC 2      | REV 13 | 750-043596 | ABBX5535 | Adapter Card           |
| ADC 3      | REV 13 | 750-043596 | ABBX5552 | Adapter Card           |
| ADC 4      | REV 13 | 750-043596 | ABBX5581 | Adapter Card           |
| ADC 5      | REV 13 | 750-043596 | ABBX5545 | Adapter Card           |
| ADC 6      | REV 13 | 750-043596 | ABBX5554 | Adapter Card           |
| ADC 7      | REV 07 | 750-043596 | ABBV7194 | Adapter Card           |
| ADC 8      | REV 07 | 750-043596 | ABBV7251 | Adapter Card           |
| ADC 9      | REV 07 | 750-043596 | ABBV7202 | Adapter Card           |
| ADC 10     | REV 13 | 750-043596 | ABBX5538 | Adapter Card           |
| ADC 11     | REV 13 | 750-043596 | ABBX5566 | Adapter Card           |
| ADC 12     | REV 13 | 750-043596 | ABBX5542 | Adapter Card           |
| ADC 13     | REV 13 | 750-043596 | ABBX5539 | Adapter Card           |
| ADC 14     | REV 13 | 750-043596 | ABBX5555 | Adapter Card           |
| ADC 15     | REV 13 | 750-043596 | ABBX5557 | Adapter Card           |
| ADC 16     | REV 13 | 750-043596 | ABBX5536 | Adapter Card           |
| ADC 17     | REV 13 | 750-043596 | ABBX5559 | Adapter Card           |
| ADC 18     | REV 13 | 750-043596 | ABBX5537 | Adapter Card           |
| ADC 19     | REV 11 | 750-043596 | ABBW5685 | Adapter Card           |
| Fan Tray 0 | REV 2A | 760-046960 | ACAY0030 | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 2A | 760-046960 | ACAY0039 | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 2A | 760-046960 | ACAY0033 | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 2A | 760-046960 | ACAY0062 | 172mm FanTray - 6 Fans |

#### show chassis hardware detail (MX2020 Router)

```

user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN11E2227AFJ  MX2020
Midplane                               ABAB9384      Lower Power Midplane
Midplane 1    REV 04    711-032386   ABAB9386      Upper Backplane
PMP 1         REV 05    711-032428   ACAJ1821      Upper Power Midplane
PMP 0         REV 04    711-032426   ACAJ1524      Lower Power Midplane
FPM Board     REV 06    760-040242   ABBT8837      Front Panel Display
PSM 0         REV 01    740-045050   1E02224006G   DC 52V Power Supply
Module
PSM 1         REV 01    740-045050   1E022240053   DC 52V Power Supply
Module
PSM 2         REV 01    740-045050   1E02224004K   DC 52V Power Supply
Module
PSM 3         REV 01    740-045050   1E022240056   DC 52V Power Supply
Module
PSM 4         REV 01    740-045050   1E022240054   DC 52V Power Supply
Module
PSM 5         REV 01    740-045050   1E02224005H   DC 52V Power Supply
Module
PSM 6         REV 01    740-045050   1E02224006S   DC 52V Power Supply
Module
PSM 7         REV 01    740-045050   1E02224005M   DC 52V Power Supply
Module
PSM 8         REV 01    740-045050   1E022240062   DC 52V Power Supply
Module
PSM 9         REV 03    740-045050   1EDB2350095   DC 52V Power Supply
Module
PSM 10        REV 03    740-045050   1EDB235009L   DC 52V Power Supply
Module
PSM 11        REV 03    740-045050   1EDB2350092   DC 52V Power Supply
Module
PSM 12        REV 03    740-045050   1EDB23500AT   DC 52V Power Supply
Module

```

|                  |        |                        |                           |                      |
|------------------|--------|------------------------|---------------------------|----------------------|
| PSM 13 Module    | REV 03 | 740-045050             | 1EDB2350094               | DC 52V Power Supply  |
| PSM 15 Module    | REV 03 | 740-045050             | 1EDB235008X               | DC 52V Power Supply  |
| PDM 0            | REV 01 | 740-045234             | 1E012150033               | DC Power Dist Module |
| PDM 1            | REV 01 | 740-045234             | 1E012150027               | DC Power Dist Module |
| PDM 2            | REV 01 | 740-045234             | 1E262250072               | DC Power Dist Module |
| Routing Engine 0 | REV 02 | 740-041821             | 9009094138                | RE-S-1800x4          |
| ad0 3998 MB      |        | Virtium - TuffDisk     | VCf3 20110825A021D0000064 | Compact Flash        |
| ad1 30533 MB     |        | UGB94ARF32H0S3-KC      | UNIGEN-499551-000347      | Disk 1               |
| usb0 (addr 1)    |        | EHCI root hub 0        | Intel                     | uhub0                |
| usb0 (addr 2)    |        | product 0x0020 32      | vendor 0x8087             | uhub1                |
| DIMM 0           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54         | MFR ID-ce80          |
| DIMM 1           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54         | MFR ID-ce80          |
| DIMM 2           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54         | MFR ID-ce80          |
| DIMM 3           |        | SGU04G72H1BD2SA-BB DIE | REV-52 PCB REV-54         | MFR ID-ce80          |
| Routing Engine 1 | REV 02 | 740-041821             | 9009089709                | RE-S-1800x4          |
| ad0 3831 MB      |        | UGB30SFA4000T1         | SFA4000T1 00000113        | Compact Flash        |
| ad1 30533 MB     |        | UGB94ARF32H0S3-KC      | UNIGEN-478612-001044      | Disk 1               |
| CB 0             | REV 08 | 750-040257             | CAAB3482                  | Control Board        |
| CB 1             | REV 04 | 750-040257             | ZT2864                    | Control Board        |
| SPMB 0           | REV 02 | 711-041855             | CAA6141                   | PMB Board            |
| SPMB 1           | REV 01 | 711-041855             | ZS2275                    | PMB Board            |
| SFB 0            | REV 05 | 711-044466             | ABBT2161                  | Switch Fabric Board  |
| SFB 1            | REV 05 | 711-044466             | ABBT2159                  | Switch Fabric Board  |
| SFB 2            | REV 05 | 711-044466             | ABBX3718                  | Switch Fabric Board  |
| SFB 3            | REV 05 | 711-044466             | ABBT2152                  | Switch Fabric Board  |
| SFB 4            | REV 05 | 711-044466             | ABBT2160                  | Switch Fabric Board  |
| SFB 5            | REV 05 | 711-044466             | ABBT2145                  | Switch Fabric Board  |
| SFB 6            | REV 05 | 711-044466             | ABBT2150                  | Switch Fabric Board  |
| SFB 7            | REV 05 | 711-044466             | ABBT2163                  | Switch Fabric Board  |
| FPC 0            | REV 30 | 750-028467             | ABBN0284                  | MPC 3D 16x 10GE      |
| CPU              | REV 10 | 711-029089             | ABBN0507                  | AMPC PMB             |
| PIC 0            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658             | B11E00990                 | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658             | B11E04357                 | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658             | B11F01327                 | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658             | B11E04375                 | SFP+-10G-USR         |
| PIC 1            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658             | B11E02760                 | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658             | B11E02904                 | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658             | B11E03963                 | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658             | B11E00756                 | SFP+-10G-USR         |
| PIC 2            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658             | B11E04418                 | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658             | B11E01077                 | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658             | B11E01128                 | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658             | B11F01253                 | SFP+-10G-USR         |
| PIC 3            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658             | B11E01140                 | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658             | B11F01626                 | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658             | B11E01075                 | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658             | B11E01177                 | SFP+-10G-USR         |
| FPC 1            | REV 30 | 750-028467             | ABBN0308                  | MPC 3D 16x 10GE      |
| CPU              | REV 10 | 711-029089             | ABBJ1095                  | AMPC PMB             |
| PIC 0            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |
| Xcvr 0           | REV 01 | 740-030658             | B11E04305                 | SFP+-10G-USR         |
| Xcvr 1           | REV 01 | 740-030658             | B11E01147                 | SFP+-10G-USR         |
| Xcvr 2           | REV 01 | 740-030658             | B11E01195                 | SFP+-10G-USR         |
| Xcvr 3           | REV 01 | 740-030658             | B11F01743                 | SFP+-10G-USR         |
| PIC 1            |        | BUILTIN                | BUILTIN                   | 4x 10GE(LAN) SFP+    |

|        |        |            |           |                   |
|--------|--------|------------|-----------|-------------------|
| Xcvr 0 | REV 01 | 740-030658 | B11F01892 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02880 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00725 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01057 | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02816 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11C04501 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E02764 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00789 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01250 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02847 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00787 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E03803 | SFP+-10G-USR      |
| FPC 2  | REV 30 | 750-028467 | ABBN0316  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABB11082  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00523 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01848 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01865 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00540 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00422 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00428 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K00423 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01855 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K01847 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00526 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K00529 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00525 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00425 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00530 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01851 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00528 | SFP+-10G-SR       |
| FPC 3  | REV 32 | 750-028467 | ABBN6832  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN6534  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MB4   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80FQ6   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N1F   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLQ   | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80KDR   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80FGJ   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N5G   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KD8   | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LET   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80N1X   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NRF   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL2   | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N3D   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MRB   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LEQ   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LER   | SFP+-10G-SR       |
| FPC 4  | REV 32 | 750-028467 | ABBN6811  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7288  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |



|        |        |            |           |                   |
|--------|--------|------------|-----------|-------------------|
| Xcvr 0 | REV 01 | 740-031980 | AK80NK8   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80LJG   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LBU   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N21   | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEU   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLM   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NL6   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LES   | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEN   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80ME0   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LMG   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80MM1   | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MG7   | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80KF9   | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NRQ   | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLE   | SFP+-10G-SR       |
| FPC 5  | REV 32 | 750-028467 | ABBN6791  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7289  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00424 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01849 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01862 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K01852 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP  |
| Xcvr 0 | REV 01 | 740-031980 | B11K00427 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K00430 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01854 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00426 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K00429 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01864 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01850 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | B11K00522 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E01144 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00985 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00796 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-031980 | B11K01866 | SFP+-10G-SR       |
| FPC 6  | REV 30 | 750-028467 | ABBM4592  | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0465  | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01435 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01052 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01328 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01254 | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02738 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02881 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01624 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00889 | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02883 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00681 | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E04306 | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02813 | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01801 | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02753 | SFP+-10G-USR      |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 2 | REV 01 | 740-030658 | B11E01156    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E04324    | SFP+-10G-USR      |
| FPC 7  | REV 32 | 750-028467 | ABBN6810     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7237     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A03058 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02082 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01674 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02638 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A03048 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02729 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02566 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02567 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02878 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02739 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01959 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02660 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02731 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02588 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02673 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02654 | SFP+-10G-SR       |
| FPC 8  | REV 30 | 750-028467 | ABBM4739     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0487     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02569 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02886 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A03082 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 133363A00297 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02726 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A03050 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02884 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03076 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02581 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02873 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02582 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03083 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031981 | UL70BU6      | SFP+-10G-LR       |
| Xcvr 1 | REV 01 | 740-031981 | UL50QC6      | SFP+-10G-LR       |
| Xcvr 2 | REV 01 | 740-031981 | UL708N6      | SFP+-10G-LR       |
| Xcvr 3 | REV 01 | 740-031981 | UL603KK      | SFP+-10G-LR       |
| FPC 9  | REV 32 | 750-028467 | ABBN6827     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6508     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A01688 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A01724 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01773 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02593 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A03061 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A03056 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02669 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03070 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02572 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02697 | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 2 | REV 01 | 740-031980 | 163363A02585 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03052 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02591 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02649 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02577 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02698 | SFP+-10G-SR       |
| FPC 10 | REV 30 | 750-028467 | ABBN0302     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0495     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01581    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01176    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01251    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02752    | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00786    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01020    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01023    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02819    | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02812    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11D04437    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01279    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01333    | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00978    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E01018    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01784    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-031980 | AK80NKP      | SFP+-10G-SR       |
| FPC 11 | REV 32 | 750-028467 | ABBN6790     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6515     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LZM      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MCC      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KCM      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KE0      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021310 | C10F99155    | SFP+-10G-LRM      |
| Xcvr 1 | REV 01 | 740-021310 | C10F99049    | SFP+-10G-LRM      |
| Xcvr 2 | REV 01 | 740-021310 | C10F99128    | SFP+-10G-LRM      |
| Xcvr 3 | REV 01 | 740-021310 | C10F99169    | SFP+-10G-LRM      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LF3      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02597 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A03060 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03057 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEX      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80FEU      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80FNM      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | AJQQQ5G      | SFP+-10G-SR       |
| FPC 12 | REV 30 | 750-028467 | ZM5111       | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ZP6607       | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LJA      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MFZ      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKL      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KF4      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80FBJ      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MM2      | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 2 | REV 01 | 740-031980 | AK80LJV      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NXV      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N1H      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLS      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80FL5      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL9      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NG2      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80KDU      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80MG1      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80MM0      | SFP+-10G-SR       |
| FPC 13 | REV 30 | 750-028467 | ABBN0208     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBJ1084     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04745    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01570    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E04388    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01439    | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04739    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01869    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01675    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01901    | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01346    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11F01288    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01824    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E04312    | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E02811    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E03847    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01495    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11F01265    | SFP+-10G-USR      |
| FPC 14 | REV 23 | 750-028467 | YN2977       | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | YP1856       | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00875 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00851 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00772 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00882 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00735 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00169 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00726 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00077 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00168 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00676 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00732 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00091 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 183363A00725 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00642 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 183363A00871 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 183363A00853 | SFP+-10G-SR       |
| FPC 15 | REV 32 | 750-028467 | ABBN6798     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBK6556     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 9ZDZ06A00055 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 183363A00239 | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| Xcvr 2 | REV 01 | 740-021308 | AD0915E003K  | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-021308 | AD0915E003A  | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80MRC      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NL5      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKN      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N3U      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N1T      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AJ808DJ      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NG4      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80FND      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80FKQ      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLT      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NKR      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LKM      | SFP+-10G-SR       |
| FPC 16 | REV 30 | 750-028467 | ABBN0270     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBJ0966     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NL1      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NXW      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KD2      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80FMD      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NKQ      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MGH      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80N38      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NL7      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80M5J      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NKD      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80KCY      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LHK      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80LEL      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MBE      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80NLG      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LFH      | SFP+-10G-SR       |
| FPC 17 | REV 32 | 750-028467 | ABBN6796     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN7259     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | B11K01856    | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | B11K01853    | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | B11K01863    | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02863 | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02668 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02881 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A01671 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02627 | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02725 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02692 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02730 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A03081 | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | 163363A02736 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | 163363A02568 | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | 163363A02747 | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | 163363A02579 | SFP+-10G-SR       |

|        |        |            |              |                   |
|--------|--------|------------|--------------|-------------------|
| FPC 18 | REV 30 | 750-028467 | ABBN0281     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN0526     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11F01326    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E03973    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E00950    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E00674    | SFP+-10G-USR      |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E00775    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E04461    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E01074    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E02821    | SFP+-10G-USR      |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04501    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E00757    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11F01623    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01022    | SFP+-10G-USR      |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-030658 | B11E04359    | SFP+-10G-USR      |
| Xcvr 1 | REV 01 | 740-030658 | B11E02751    | SFP+-10G-USR      |
| Xcvr 2 | REV 01 | 740-030658 | B11E02736    | SFP+-10G-USR      |
| Xcvr 3 | REV 01 | 740-030658 | B11E01178    | SFP+-10G-USR      |
| FPC 19 | REV 32 | 750-028467 | ABBN6813     | MPC 3D 16x 10GE   |
| CPU    | REV 10 | 711-029089 | ABBN6542     | AMPC PMB          |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NA3      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80NLF      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80MRH      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80KE4      | SFP+-10G-SR       |
| PIC 1  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-021308 | 973152A00030 | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80L9H      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80ME8      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80NLR      | SFP+-10G-SR       |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80NG1      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80MCA      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LFC      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80LEM      | SFP+-10G-SR       |
| PIC 3  |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+ |
| Xcvr 0 | REV 01 | 740-031980 | AK80N9X      | SFP+-10G-SR       |
| Xcvr 1 | REV 01 | 740-031980 | AK80LAC      | SFP+-10G-SR       |
| Xcvr 2 | REV 01 | 740-031980 | AK80LF2      | SFP+-10G-SR       |
| Xcvr 3 | REV 01 | 740-031980 | AK80N8T      | SFP+-10G-SR       |
| ADC 0  | REV 13 | 750-043596 | ABBX5561     | Adapter Card      |
| ADC 1  | REV 13 | 750-043596 | ABBX5546     | Adapter Card      |
| ADC 2  | REV 13 | 750-043596 | ABBX5535     | Adapter Card      |
| ADC 3  | REV 13 | 750-043596 | ABBX5552     | Adapter Card      |
| ADC 4  | REV 13 | 750-043596 | ABBX5581     | Adapter Card      |
| ADC 5  | REV 13 | 750-043596 | ABBX5545     | Adapter Card      |
| ADC 6  | REV 13 | 750-043596 | ABBX5554     | Adapter Card      |
| ADC 7  | REV 07 | 750-043596 | ABBV7194     | Adapter Card      |
| ADC 8  | REV 07 | 750-043596 | ABBV7251     | Adapter Card      |
| ADC 9  | REV 07 | 750-043596 | ABBV7202     | Adapter Card      |
| ADC 10 | REV 13 | 750-043596 | ABBX5579     | Adapter Card      |
| ADC 11 | REV 13 | 750-043596 | ABBX5548     | Adapter Card      |
| ADC 12 | REV 13 | 750-043596 | ABBX5575     | Adapter Card      |
| ADC 13 | REV 13 | 750-043596 | ABBX5539     | Adapter Card      |
| ADC 14 | REV 13 | 750-043596 | ABBX5555     | Adapter Card      |
| ADC 15 | REV 13 | 750-043596 | ABBX5557     | Adapter Card      |
| ADC 16 | REV 13 | 750-043596 | ABBX5536     | Adapter Card      |

|            |        |            |          |                        |
|------------|--------|------------|----------|------------------------|
| ADC 17     | REV 13 | 750-043596 | ABBX5559 | Adapter Card           |
| ADC 18     | REV 13 | 750-043596 | ABBX5537 | Adapter Card           |
| ADC 19     | REV 11 | 750-043596 | ABBW5685 | Adapter Card           |
| Fan Tray 0 | REV 04 | 760-046960 | ACAY0090 | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 04 | 760-046960 | ACAY0088 | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 04 | 760-046960 | ACAY0089 | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 04 | 760-046960 | ACAY0108 | 172mm FanTray - 6 Fans |

### show chassis hardware models (MX2020 Router)

```
user@host > show chassis hardware models
```

Hardware inventory:

| Item             | Version | Part number | Serial number | FRU model number     |
|------------------|---------|-------------|---------------|----------------------|
| Midplane         | REV 27  | 750-040240  | ABAB9384      | 750-040240           |
| FPM Board        | REV 06  | 760-040242  | ABBT8837      | 760-040242           |
| PSM 0            | REV 01  | 740-045050  | 1E02224006G   | MX2000-PSM-HC-DC-S-A |
| PSM 1            | REV 01  | 740-045050  | 1E022240053   | MX2000-PSM-HC-DC-S-A |
| PSM 2            | REV 01  | 740-045050  | 1E02224004K   | MX2000-PSM-HC-DC-S-A |
| PSM 3            | REV 01  | 740-045050  | 1E022240056   | MX2000-PSM-HC-DC-S-A |
| PSM 4            | REV 01  | 740-045050  | 1E022240054   | MX2000-PSM-HC-DC-S-A |
| PSM 5            | REV 01  | 740-045050  | 1E02224005H   | MX2000-PSM-HC-DC-S-A |
| PSM 6            | REV 01  | 740-045050  | 1E02224006S   | MX2000-PSM-HC-DC-S-A |
| PSM 7            | REV 01  | 740-045050  | 1E02224005M   | MX2000-PSM-HC-DC-S-A |
| PSM 8            | REV 01  | 740-045050  | 1E022240062   | MX2000-PSM-HC-DC-S-A |
| PSM 9            | REV 03  | 740-045050  | 1EDB2350095   | MX2000-PSM-DC-S-A    |
| PSM 10           | REV 03  | 740-045050  | 1EDB235009L   | MX2000-PSM-DC-S-A    |
| PSM 11           | REV 03  | 740-045050  | 1EDB2350092   | MX2000-PSM-DC-S-A    |
| PSM 12           | REV 03  | 740-045050  | 1EDB23500AT   | MX2000-PSM-DC-S-A    |
| PSM 13           | REV 03  | 740-045050  | 1EDB2350094   | MX2000-PSM-DC-S-A    |
| PSM 15           | REV 03  | 740-045050  | 1EDB235008X   | MX2000-PSM-DC-S-A    |
| PDM 0            | REV 01  | 740-045234  | 1E012150033   |                      |
| PDM 1            | REV 01  | 740-045234  | 1E012150027   |                      |
| PDM 2            | REV 01  | 740-045234  | 1E262250072   | MX2000-PDM-DC-S-A    |
| Routing Engine 0 | REV 02  | 740-041821  | 9009094138    | RE-S-1800X4-16G-S    |
| Routing Engine 1 | REV 02  | 740-041821  | 9009089709    | RE-S-1800X4-16G-S    |
| CB 0             | REV 08  | 750-040257  | CAAB3482      | 750-040257           |
| CB 1             | REV 04  | 750-040257  | ZT2864        | 750-040257           |
| SFB 0            | REV 05  | 711-044466  | ABBT2161      | MX2000-SFB-S         |
| SFB 1            | REV 05  | 711-044466  | ABBT2159      | MX2000-SFB-S         |
| SFB 2            | REV 05  | 711-044466  | ABBX3718      | MX2000-SFB-S         |
| SFB 4            | REV 05  | 711-044466  | ABBT2160      | MX2000-SFB-S         |
| SFB 5            | REV 05  | 711-044466  | ABBT2145      | MX2000-SFB-S         |
| SFB 7            | REV 05  | 711-044466  | ABBT2163      | MX2000-SFB-S         |
| FPC 0            | REV 30  | 750-028467  | ABBN0284      | MPC-3D-16XGE-SFPP    |
| FPC 1            | REV 30  | 750-028467  | ABBN0308      | MPC-3D-16XGE-SFPP    |
| FPC 2            | REV 30  | 750-028467  | ABBN0316      | MPC-3D-16XGE-SFPP    |
| FPC 3            | REV 32  | 750-028467  | ABBN6832      | MPC-3D-16XGE-SFPP    |
| FPC 4            | REV 32  | 750-028467  | ABBN6811      | MPC-3D-16XGE-SFPP    |
| FPC 5            | REV 32  | 750-028467  | ABBN6791      | MPC-3D-16XGE-SFPP    |
| FPC 6            | REV 30  | 750-028467  | ABBM4592      | MPC-3D-16XGE-SFPP    |
| FPC 7            | REV 32  | 750-028467  | ABBN6810      | MPC-3D-16XGE-SFPP    |
| FPC 8            | REV 30  | 750-028467  | ABBM4739      | MPC-3D-16XGE-SFPP    |
| FPC 9            | REV 32  | 750-028467  | ABBN6827      | MPC-3D-16XGE-SFPP    |
| FPC 10           | REV 30  | 750-028467  | ABBN0302      | MPC-3D-16XGE-SFPP    |
| FPC 11           | REV 32  | 750-028467  | ABBN6790      | MPC-3D-16XGE-SFPP    |
| FPC 12           | REV 30  | 750-028467  | ZM5111        | MPC-3D-16XGE-SFPP    |
| FPC 13           | REV 30  | 750-028467  | ABBN0208      | MPC-3D-16XGE-SFPP    |
| FPC 14           | REV 23  | 750-028467  | YN2977        | MPC-3D-16XGE-SFPP    |
| FPC 15           | REV 32  | 750-028467  | ABBN6798      | MPC-3D-16XGE-SFPP    |
| FPC 16           | REV 30  | 750-028467  | ABBN0270      | MPC-3D-16XGE-SFPP    |
| FPC 17           | REV 32  | 750-028467  | ABBN6796      | MPC-3D-16XGE-SFPP    |

|            |        |            |          |                   |
|------------|--------|------------|----------|-------------------|
| FPC 18     | REV 30 | 750-028467 | ABBN0281 | MPC-3D-16XGE-SFPP |
| FPC 19     | REV 32 | 750-028467 | ABBN6813 | MPC-3D-16XGE-SFPP |
| ADC 0      | REV 13 | 750-043596 | ABBX5561 | PROTO-ASSEMBLY    |
| ADC 1      | REV 13 | 750-043596 | ABBX5546 | PROTO-ASSEMBLY    |
| ADC 2      | REV 13 | 750-043596 | ABBX5535 | MX2000-LC-ADAPTER |
| ADC 3      | REV 13 | 750-043596 | ABBX5552 | MX2000-LC-ADAPTER |
| ADC 4      | REV 13 | 750-043596 | ABBX5581 | MX2000-LC-ADAPTER |
| ADC 5      | REV 13 | 750-043596 | ABBX5545 | PROTO-ASSEMBLY    |
| ADC 6      | REV 13 | 750-043596 | ABBX5554 | PROTO-ASSEMBLY    |
| ADC 7      | REV 07 | 750-043596 | ABBV7194 | MX2000-LC-ADAPTER |
| ADC 8      | REV 07 | 750-043596 | ABBV7251 | MX2000-LC-ADAPTER |
| ADC 9      | REV 07 | 750-043596 | ABBV7202 | MX2000-LC-ADAPTER |
| ADC 10     | REV 13 | 750-043596 | ABBX5579 | MX2000-LC-ADAPTER |
| ADC 12     | REV 13 | 750-043596 | ABBX5575 | MX2000-LC-ADAPTER |
| ADC 13     | REV 13 | 750-043596 | ABBX5539 | PROTO-ASSEMBLY    |
| ADC 14     | REV 13 | 750-043596 | ABBX5555 | PROTO-ASSEMBLY    |
| ADC 15     | REV 13 | 750-043596 | ABBX5557 | MX2000-LC-ADAPTER |
| ADC 16     | REV 13 | 750-043596 | ABBX5536 | PROTO-ASSEMBLY    |
| ADC 17     | REV 13 | 750-043596 | ABBX5559 | PROTO-ASSEMBLY    |
| ADC 18     | REV 13 | 750-043596 | ABBX5537 | PROTO-ASSEMBLY    |
| ADC 19     | REV 11 | 750-043596 | ABBW5685 | PROTO-ASSEMBLY    |
| Fan Tray 0 | REV 04 | 760-046960 | ACAY0090 |                   |
| Fan Tray 1 | REV 04 | 760-046960 | ACAY0088 |                   |
| Fan Tray 2 | REV 04 | 760-046960 | ACAY0089 |                   |
| Fan Tray 3 | REV 04 | 760-046960 | ACAY0108 |                   |

#### show chassis hardware clei-models (MX2020 Router)

```
user@ host > show chassis hardware clei-models
```

Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number     |
|------------------|---------|-------------|------------|----------------------|
| Midplane         | REV 27  | 750-040240  | PROTOXCLEI | 750-040240           |
| FPM Board        | REV 06  | 760-040242  | PROTOXCLEI | 760-040242           |
| PSM 0            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 1            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 2            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 3            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 4            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 5            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 6            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 7            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 8            | REV 01  | 740-045050  | IPUPAJMKAA | MX2000-PSM-HC-DC-S-A |
| PSM 9            | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PSM 10           | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PSM 11           | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PSM 12           | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PSM 13           | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PSM 15           | REV 03  | 740-045050  | IPUPAJMKAA | MX2000-PSM-DC-S-A    |
| PDM 0            | REV 01  | 740-045234  |            |                      |
| PDM 1            | REV 01  | 740-045234  |            |                      |
| PDM 2            | REV 01  | 740-045234  | IPUPAJSKAA | MX2000-PDM-DC-S-A    |
| Routing Engine 0 | REV 02  | 740-041821  |            | RE-S-1800X4-16G-S    |
| Routing Engine 1 | REV 02  | 740-041821  |            | RE-S-1800X4-16G-S    |
| CB 0             | REV 08  | 750-040257  | PROTOXCLEI | 750-040257           |
| CB 1             | REV 04  | 750-040257  | PROTOXCLEI | 750-040257           |
| SFB 0            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |
| SFB 1            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |
| SFB 2            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |
| SFB 4            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |
| SFB 5            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |
| SFB 7            | REV 05  | 711-044466  | IPUCBA6CAA | MX2000-SFB-S         |



|            |        |            |            |                   |
|------------|--------|------------|------------|-------------------|
| FPC 0      | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 1      | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 2      | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 3      | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 4      | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 5      | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 6      | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 7      | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 8      | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 9      | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 10     | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 11     | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 12     | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 13     | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 14     | REV 23 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 15     | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 16     | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 17     | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 18     | REV 30 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| FPC 19     | REV 32 | 750-028467 |            | MPC-3D-16XGE-SFPP |
| ADC 0      | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 1      | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 2      | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 3      | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 4      | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 5      | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 6      | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 7      | REV 07 | 750-043596 | PROTOXCLEI | MX2000-LC-ADAPTER |
| ADC 8      | REV 07 | 750-043596 | PROTOXCLEI | MX2000-LC-ADAPTER |
| ADC 9      | REV 07 | 750-043596 | PROTOXCLEI | MX2000-LC-ADAPTER |
| ADC 10     | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 12     | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 13     | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 14     | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 15     | REV 13 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER |
| ADC 16     | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 17     | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 18     | REV 13 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| ADC 19     | REV 11 | 750-043596 | PROTOXCLEI | PROTO-ASSEMBLY    |
| Fan Tray 0 | REV 04 | 760-046960 |            |                   |
| Fan Tray 1 | REV 04 | 760-046960 |            |                   |
| Fan Tray 2 | REV 04 | 760-046960 |            |                   |
| Fan Tray 3 | REV 04 | 760-046960 |            |                   |

### show chassis hardware (MX2020 Router with MPC5EQ and MPC6E)

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item       | Version | Part number | Serial number | Description          |
|------------|---------|-------------|---------------|----------------------|
| Chassis    |         |             | JN120BADBAFJ  | MX2020               |
| Midplane   | REV 51  | 750-040240  | ABAB9243      | Lower Backplane      |
| Midplane 1 | REV 04  | 711-032386  | ABAB9399      | Upper Backplane      |
| PMP 1      | REV 05  | 711-032428  | ACAJ2541      | Upper Power Midplane |
| PMP 0      | REV 04  | 711-032426  | ACAJ2194      | Lower Power Midplane |
| FPM Board  | REV 13  | 760-040242  | ABCA8835      | Front Panel Display  |
| PSM 0      | REV 01  | 740-050037  | 1EDB32403L5   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 1      | REV 01  | 740-050037  | 1EDB32403L3   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 2      | REV 01  | 740-050037  | 1EDB32403KM   | DC 52V Power Supply  |
| Module     |         |             |               |                      |

|                  |        |            |              |                        |
|------------------|--------|------------|--------------|------------------------|
| PSM 3 Module     | REV 01 | 740-050037 | 1EDB3130079  | DC 52V Power Supply    |
| PSM 4 Module     | REV 01 | 740-050037 | 1EDB3130077  | DC 52V Power Supply    |
| PSM 5 Module     | REV 01 | 740-050037 | 1EDB3130020  | DC 52V Power Supply    |
| PSM 6 Module     | REV 01 | 740-050037 | 1EDB313009S  | DC 52V Power Supply    |
| PSM 7 Module     | REV 01 | 740-050037 | 1EDB313008E  | DC 52V Power Supply    |
| PSM 8 Module     | REV 01 | 740-050037 | 1EDB3130063  | DC 52V Power Supply    |
| PSM 12 Module    | REV 01 | 740-050037 | 1EDB3130026  | DC 52V Power Supply    |
| PSM 13 Module    | REV 01 | 740-050037 | 1EDB3130074  | DC 52V Power Supply    |
| PSM 14 Module    | REV 01 | 740-050037 | 1EDB313009D  | DC 52V Power Supply    |
| PSM 15 Module    | REV 01 | 740-050037 | 1EDB3130024  | DC 52V Power Supply    |
| PSM 16 Module    | REV 01 | 740-050037 | 1EDB3130054  | DC 52V Power Supply    |
| PSM 17 Module    | REV 01 | 740-050037 | 1EDB3130080  | DC 52V Power Supply    |
| PDM 0            | REV 03 | 740-045234 | 1EGA3170144  | DC Power Dist Module   |
| PDM 1            | REV 03 | 740-045234 | 1EGA3170158  | DC Power Dist Module   |
| PDM 2            | REV 03 | 740-045234 | 1EGA3170182  | DC Power Dist Module   |
| PDM 3            | REV 03 | 740-045234 | 1EGA3170207  | DC Power Dist Module   |
| Routing Engine 0 | REV 02 | 740-041821 | 9009112112   | RE-S-1800x4            |
| Routing Engine 1 | REV 02 | 740-041821 | 9009112087   | RE-S-1800x4            |
| CB 0             | REV 23 | 750-040257 | CABA2295     | Control Board          |
| CB 1             | REV 23 | 750-040257 | CABE8379     | Control Board          |
| SPMB 0           | REV 02 | 711-041855 | ABCE8851     | PMB Board              |
| SPMB 1           | REV 02 | 711-041855 | ABCE8839     | PMB Board              |
| SFB 0            | REV 06 | 711-044466 | ABCD5001     | Switch Fabric Board    |
| SFB 1            | REV 06 | 711-044466 | ABCD5034     | Switch Fabric Board    |
| SFB 2            | REV 06 | 711-044466 | ABCH3899     | Switch Fabric Board    |
| SFB 3            | REV 06 | 711-044466 | ABCD5020     | Switch Fabric Board    |
| SFB 4            | REV 06 | 711-044466 | ABCD4975     | Switch Fabric Board    |
| SFB 5            | REV 06 | 711-044466 | ABCH3881     | Switch Fabric Board    |
| SFB 6            | REV 06 | 711-044466 | ABCD5026     | Switch Fabric Board    |
| SFB 7            | REV 06 | 711-044466 | ABCD5032     | Switch Fabric Board    |
| FPC 0            | REV 39 | 750-045715 | CACD1902     | MPC5E 3D Q 24XGE+6XLGE |
| CPU              | REV 09 | 711-045719 | CACB1933     | RMPC PMB               |
| PIC 0            |        | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| Xcvr 0           | REV 01 | 740-031980 | B11F00361    | SFP+-10G-SR            |
| Xcvr 2           | REV 01 | 740-021308 | 19T511101854 | SFP+-10G-SR            |
| Xcvr 3           | REV 01 | 740-021308 | 19T511100377 | SFP+-10G-SR            |
| Xcvr 4           | REV 01 | 740-031980 | ANT0878      | SFP+-10G-SR            |
| Xcvr 5           | REV 01 | 740-021308 | 19T511100398 | SFP+-10G-SR            |
| Xcvr 6           | REV 01 | 740-021308 | AQ4363J      | SFP+-10G-SR            |
| Xcvr 7           | REV 01 | 740-021308 | 19T511101377 | SFP+-10G-SR            |
| Xcvr 8           | REV 01 | 740-031980 | ANT072M      | SFP+-10G-SR            |
| Xcvr 9           | REV 01 | 740-021308 | AG90C7N      | SFP+-10G-SR            |
| Xcvr 10          | REV 01 | 740-031980 | AM30M09      | SFP+-10G-SR            |
| Xcvr 11          | REV 01 | 740-031980 | B10E01016    | SFP+-10G-SR            |
| PIC 1            |        | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| Xcvr 0           | REV 01 | 740-031980 | B10L04151    | SFP+-10G-SR            |
| Xcvr 1           | REV 01 | 740-021308 | 19T511101379 | SFP+-10G-SR            |
| Xcvr 2           | REV 01 | 740-021308 | AQ5036J      | SFP+-10G-SR            |
| Xcvr 3           | REV 01 | 740-021308 | AG90C4M      | SFP+-10G-SR            |

|          |        |            |              |                      |
|----------|--------|------------|--------------|----------------------|
| Xcvr 4   | REV 01 | 740-021308 | 19T511101104 | SFP+-10G-SR          |
| Xcvr 5   | REV 01 | 740-021308 | AQ502ZM      | SFP+-10G-SR          |
| Xcvr 6   | REV 01 | 740-021308 | AN10KY2      | SFP+-10G-SR          |
| Xcvr 7   | REV 01 | 740-021308 | AQ43G41      | SFP+-10G-SR          |
| Xcvr 8   | REV 01 | 740-021308 | AQ41F04      | SFP+-10G-SR          |
| Xcvr 9   | REV 01 | 740-031980 | AMS16N3      | SFP+-10G-SR          |
| Xcvr 10  | REV 01 | 740-021308 | AMH04Y3      | SFP+-10G-SR          |
| Xcvr 11  | REV 01 | 740-021308 | ANA093E      | SFP+-10G-SR          |
| PIC 2    |        | BUILTIN    | BUILTIN      | 3X40GE QSFPP         |
| PIC 3    |        | BUILTIN    | BUILTIN      | 3X40GE QSFPP         |
| WAN MEZZ | REV 09 | 750-049136 | CABN0410     | MPC5E 24XGE OTN Mezz |
| FPC 1    | REV 11 | 750-045372 | CABK8112     | MPCE Type 3 3D       |
| CPU      | REV 08 | 711-035209 | CABJ6621     | HMPC PMB 2G          |
| MIC 0    | REV 07 | 750-033307 | CAAZ2897     | 10X10GE SFPP         |
| PIC 0    |        | BUILTIN    | BUILTIN      | 10X10GE SFPP         |
| Xcvr 0   | REV 01 | 740-021308 | AQ501VK      | SFP+-10G-SR          |
| Xcvr 1   | REV 01 | 740-021308 | AQ501YC      | SFP+-10G-SR          |
| Xcvr 2   | REV 01 | 740-021308 | AQ43HJF      | SFP+-10G-SR          |
| Xcvr 3   | REV 01 | 740-021308 | AQ43H8D      | SFP+-10G-SR          |
| Xcvr 4   | REV 01 | 740-021308 | 19T511100370 | SFP+-10G-SR          |
| Xcvr 5   | REV 01 | 740-031980 | 153363A00763 | SFP+-10G-SR          |
| Xcvr 6   | REV 01 | 740-021308 | APH2LXB      | SFP+-10G-SR          |
| Xcvr 7   | REV 01 | 740-031980 | AMC0LVV      | SFP+-10G-SR          |
| Xcvr 8   | REV 01 | 740-031980 | B11F00230    | SFP+-10G-SR          |
| MIC 1    | REV 14 | 750-033196 | CAAP1390     | 1X100GE CXP          |
| PIC 2    |        | BUILTIN    | BUILTIN      | 1X100GE CXP          |
| Xcvr 0   | REV 01 | 740-032166 | XB11F000M    | CFP2-100G-SR10       |
| FPC 2    | REV 17 | 750-037355 | CAAS5826     | MPC4E 3D 2CGE+8XGE   |
| CPU      | REV 08 | 711-035209 | CAAR3986     | HMPC PMB 2G          |
| PIC 0    |        | BUILTIN    | BUILTIN      | 4x10GE SFPP          |
| Xcvr 0   | REV 01 | 740-021308 | T09F43722    | SFP+-10G-SR          |
| Xcvr 1   | REV 01 | 740-031980 | ALP0KXF      | SFP+-10G-SR          |
| Xcvr 2   | REV 01 | 740-021308 | AQ502FG      | SFP+-10G-SR          |
| Xcvr 3   | REV 01 | 740-021308 | AQ502T7      | SFP+-10G-SR          |
| PIC 1    |        | BUILTIN    | BUILTIN      | 1X100GE CFP          |
| Xcvr 0   | REV 01 | 740-035329 | X12J00571    | CFP-100G-SR10        |
| PIC 2    |        | BUILTIN    | BUILTIN      | 4x10GE SFPP          |
| Xcvr 0   | REV 01 | 740-031980 | AJ71KEH      | SFP+-10G-SR          |
| Xcvr 1   | REV 01 | 740-031980 | B11E01355    | SFP+-10G-SR          |
| Xcvr 3   | REV 01 | 740-031980 | B11F00249    | SFP+-10G-SR          |
| PIC 3    |        | BUILTIN    | BUILTIN      | 1X100GE CFP          |
| FPC 3    | REV 05 | 750-044444 | CAAY9920     | MPCE Type 2 3D P     |
| CPU      | REV 04 | 711-038484 | CAAW3639     | MPCE PMB 2G          |
| MIC 0    | REV 28 | 750-028387 | CAAX1083     | 3D 4x 10GE XFP       |
| PIC 0    |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| Xcvr 0   |        | NON-JNPR   | CC07BK05B    | XFP-10G-SR           |
| Xcvr 1   | REV 01 | 740-011571 | C728XJ00U    | XFP-10G-SR           |
| PIC 1    |        | BUILTIN    | BUILTIN      | 2x 10GE XFP          |
| Xcvr 0   |        | NON-JNPR   | T12L92339    | XFP-10G-SR           |
| QXM 0    | REV 06 | 711-028408 | CAAW4915     | MPC QXM              |
| QXM 1    | REV 06 | 711-028408 | CAAW4894     | MPC QXM              |
| FPC 4    | REV 18 | 750-046005 | CACH5661     | MPC5E 3D Q 2CGE+4XGE |
| CPU      | REV 09 | 711-045719 | CACF2880     | RMPC PMB             |
| PIC 0    |        | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN      |
| PIC 1    |        | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN     |
| Xcvr 0   | REV 01 | 740-046563 | XD16FC03Y    | CFP2-100G-SR10       |
| PIC 2    |        | BUILTIN    | BUILTIN      | 2X10GE SFPP OTN      |
| PIC 3    |        | BUILTIN    | BUILTIN      | 1X100GE CFP2 OTN     |
| Xcvr 0   | REV 01 | 740-049775 | J13K72997    | CFP2-100G-LR4-D      |
| FPC 5    | REV 35 | 750-028467 | CAAR2623     | MPC 3D 16x 10GE      |
| CPU      | REV 11 | 711-029089 | CAAR0491     | AMPC PMB             |

|         |             |            |           |           |                   |
|---------|-------------|------------|-----------|-----------|-------------------|
| PIC 0   |             |            | BUILTIN   | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0  | REV 01      | 740-021308 | AQ5027T   |           | SFP+-10G-SR       |
| Xcvr 1  | REV 01      | 740-021308 | AQ502J0   |           | SFP+-10G-SR       |
| Xcvr 2  | REV 01      | 740-021308 | AQ5027S   |           | SFP+-10G-SR       |
| Xcvr 3  | REV 01      | 740-021308 | AQ501Y7   |           | SFP+-10G-SR       |
| PIC 1   |             |            | BUILTIN   | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0  | REV 01      | 740-021308 | AQ501YB   |           | SFP+-10G-SR       |
| Xcvr 1  | REV 01      | 740-021308 | AQ503EB   |           | SFP+-10G-SR       |
| Xcvr 2  | REV 01      | 740-021308 | AQ43HJH   |           | SFP+-10G-SR       |
| Xcvr 3  | REV 01      | 740-021308 | AQ43J0Y   |           | SFP+-10G-SR       |
| PIC 2   |             |            | BUILTIN   | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0  | REV 01      | 740-021308 | AQ50352   |           | SFP+-10G-SR       |
| Xcvr 1  | REV 01      | 740-021308 | AQ501X6   |           | SFP+-10G-SR       |
| Xcvr 2  | REV 01      | 740-021308 | AQ502NV   |           | SFP+-10G-SR       |
| Xcvr 3  | REV 01      | 740-021308 | AQ502ZJ   |           | SFP+-10G-SR       |
| PIC 3   |             |            | BUILTIN   | BUILTIN   | 4x 10GE(LAN) SFP+ |
| Xcvr 0  | REV 01      | 740-021308 | AQ502H4   |           | SFP+-10G-SR       |
| Xcvr 1  | REV 01      | 740-021308 | AQ43HJK   |           | SFP+-10G-SR       |
| Xcvr 2  | REV 01      | 740-031980 | AJ30CU7   |           | SFP+-10G-SR       |
| FPC 9   | REV 30      | 750-044130 | ABCF5773  |           | MPC6E 3D          |
| CPU     | REV 09      | 711-045719 | ABCF1270  |           | RMPD PMB          |
| MIC 0   | REV 05      | 750-049457 | ABCD7829  |           | 2X100GE CFP2 OTN  |
| PIC 0   |             |            | BUILTIN   | BUILTIN   | 2X100GE CFP2 OTN  |
| Xcvr 0  |             |            | NON-JNPR  | FE13F000K | CFP2-100G-SR10    |
| Xcvr 1  | REV 01      | 740-048813 | XD32FE017 |           | CFP2-100G-LR-D    |
| MIC 1   | REV 07      | 750-049457 | ABCK2812  |           | 2X100GE CFP2 OTN  |
| PIC 1   |             |            | BUILTIN   | BUILTIN   | 2X100GE CFP2 OTN  |
| Xcvr 0  | REV 01      | 740-048813 | XD32FE018 |           | CFP2-100G-SR10    |
| Xcvr 1  |             |            | NON-JNPR  | FE13F000E | CFP2-100G-LR4-D   |
| XLM 0   | REV 05.2.00 | 711-046638 | ABCF5915  |           | MPC6E XL          |
| XLM 1   | REV 05.2.00 | 711-046638 | ABCF5916  |           | MPC6E XL          |
| FPC 10  | REV 36      | 750-044130 | ABCS8602  |           | MPC6E 3D          |
| CPU     | REV 09      | 711-045719 | ABCS8779  |           | RMPD PMB          |
| MIC 0   | REV 06      | 750-049979 | ABCK2656  |           | 24X10GE SFPP OTN  |
| PIC 0   |             |            | BUILTIN   | BUILTIN   | 24X10GE SFPP OTN  |
| Xcvr 0  | REV 01      | 740-021308 | AQ43J08   |           | SFP+-10G-SR       |
| Xcvr 1  | REV 01      | 740-021308 | AQE1Y2E   |           | SFP+-10G-SR       |
| Xcvr 2  | REV 01      | 740-021308 | AQE1UW4   |           | SFP+-10G-SR       |
| Xcvr 3  | REV 01      | 740-021308 | AQE1MQF   |           | SFP+-10G-SR       |
| Xcvr 4  | REV 01      | 740-021308 | AQGOMN1   |           | SFP+-10G-SR       |
| Xcvr 5  | REV 01      | 740-021308 | AQE1L9M   |           | SFP+-10G-SR       |
| Xcvr 6  | REV 01      | 740-021308 | AQGOMPD   |           | SFP+-10G-SR       |
| Xcvr 7  | REV 01      | 740-021308 | AQE1Y2B   |           | SFP+-10G-SR       |
| Xcvr 8  | REV 01      | 740-021308 | AQGOLT5   |           | SFP+-10G-SR       |
| Xcvr 9  | REV 01      | 740-021308 | AQD2ET4   |           | SFP+-10G-SR       |
| Xcvr 10 | REV 01      | 740-021308 | AQGOMPC   |           | SFP+-10G-SR       |
| Xcvr 11 | REV 01      | 740-021308 | AQGOM63   |           | SFP+-10G-SR       |
| Xcvr 12 | REV 01      | 740-021308 | AQGOLT1   |           | SFP+-10G-SR       |
| Xcvr 13 | REV 01      | 740-021308 | AQGOM4L   |           | SFP+-10G-SR       |
| Xcvr 14 | REV 01      | 740-021308 | AQGOLS7   |           | SFP+-10G-SR       |
| Xcvr 15 | REV 01      | 740-021308 | AQE1MQB   |           | SFP+-10G-SR       |
| Xcvr 16 | REV 01      | 740-021308 | AQGOLZP   |           | SFP+-10G-SR       |
| Xcvr 17 | REV 01      | 740-021308 | AQE1LU9   |           | SFP+-10G-SR       |
| Xcvr 18 | REV 01      | 740-021308 | AQGOMRZ   |           | SFP+-10G-SR       |
| Xcvr 19 | REV 01      | 740-021308 | AQE1MQ9   |           | SFP+-10G-SR       |
| Xcvr 20 | REV 01      | 740-021308 | AQGOLRX   |           | SFP+-10G-SR       |
| Xcvr 21 | REV 01      | 740-021308 | AQE1UWD   |           | SFP+-10G-SR       |
| Xcvr 22 | REV 01      | 740-021308 | AQGOLT4   |           | SFP+-10G-SR       |
| Xcvr 23 | REV 01      | 740-021308 | AQE1MQL   |           | SFP+-10G-SR       |
| MIC 1   | REV 12      | 750-050008 | ABCK5372  |           | 4X100GE CXP       |
| PIC 1   |             |            | BUILTIN   | BUILTIN   | 4X100GE CXP       |

|          |             |            |              |                        |
|----------|-------------|------------|--------------|------------------------|
| Xcvr 3   | REV 01      | 740-046563 | XD16FC02Z    | CFP2-100G-SR10         |
| XLM 0    | REV 07.2.00 | 711-046638 | ABCK3481     | MPC6E XL               |
| XLM 1    | REV 07.2.00 | 711-046638 | ABCK4725     | MPC6E XL               |
| FPC 17   | REV 28      | 750-044130 | ABBZ3873     | MPC6E 3D               |
| CPU      | REV 08      | 711-045719 | ABBZ3770     | RMP C PMB              |
| MIC 0    | REV 11      | 750-046535 | ABCC7731     | 24X10GE SFPP           |
| PIC 0    |             | BUILTIN    | BUILTIN      | 24X10GE SFPP           |
| Xcvr 1   | REV 01      | 740-021308 | APK0543      | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-031980 | B10G01119    | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQ502SX      | SFP+-10G-SR            |
| Xcvr 4   | REV 01      | 740-021308 | AQ43H84      | SFP+-10G-SR            |
| Xcvr 5   | REV 01      | 740-021308 | AQ501TB      | SFP+-10G-SR            |
| Xcvr 6   | REV 01      | 740-021308 | AQ502JZ      | SFP+-10G-SR            |
| Xcvr 7   | REV 01      | 740-021308 | AQ502SC      | SFP+-10G-SR            |
| Xcvr 8   | REV 01      | 740-021308 | AQ502JW      | SFP+-10G-SR            |
| Xcvr 9   | REV 01      | 740-021308 | AQ502RM      | SFP+-10G-SR            |
| Xcvr 10  | REV 01      | 740-031980 | AHK013B      | SFP+-10G-SR            |
| Xcvr 11  | REV 01      | 740-021308 | AQGOMRT      | SFP+-10G-SR            |
| Xcvr 13  | REV 01      | 740-031980 | AMCOJTC      | SFP+-10G-SR            |
| Xcvr 14  | REV 01      | 740-021308 | ANAOMQ0      | SFP+-10G-SR            |
| Xcvr 15  | REV 01      | 740-021308 | AQ502GS      | SFP+-10G-SR            |
| Xcvr 16  | REV 01      | 740-021308 | AQGOM0J      | SFP+-10G-SR            |
| Xcvr 17  | REV 01      | 740-021308 | AQGOMUR      | SFP+-10G-SR            |
| Xcvr 18  | REV 01      | 740-021308 | AQGOMRR      | SFP+-10G-SR            |
| Xcvr 19  | REV 01      | 740-021308 | AQGOM0F      | SFP+-10G-SR            |
| Xcvr 20  | REV 01      | 740-021308 | AQ50312      | SFP+-10G-SR            |
| Xcvr 21  | REV 01      | 740-021308 | AQ5032U      | SFP+-10G-SR            |
| Xcvr 22  | REV 01      | 740-021308 | APE17B5      | SFP+-10G-SR            |
| Xcvr 23  | REV 01      | 740-021309 | 91D104A00011 | SFP+-10G-LR            |
| MIC 1    | REV 03      | 750-050008 | ABCC4522     | 4X100GE CXP            |
| PIC 1    |             | BUILTIN    | BUILTIN      | 4X100GE CXP            |
| Xcvr 0   | REV 01      | 740-046563 | XD16FC02U    | CFP2-100G-SR10         |
| Xcvr 1   | REV 01      | 740-046563 | XC42FC03K    | CFP2-100G-SR10         |
| Xcvr 2   | REV 01      | 740-046563 | XC42FC01Z    | CFP2-100G-SR10         |
| Xcvr 3   | REV 01      | 740-046563 | XC42FC02U    | CFP2-100G-SR10         |
| XLM 0    | REV 04.2.00 | 711-046638 | ABBZ3779     | MPC6E XL               |
| XLM 1    | REV 04.2.00 | 711-046638 | ABBZ3780     | MPC6E XL               |
| FPC 18   | REV 39      | 750-045715 | CACD1910     | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 09      | 711-045719 | CACD1817     | RMP C PMB              |
| PIC 0    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| PIC 1    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| PIC 2    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QD130194     | QSFP+-40G-SR4          |
| Xcvr 1   | REV 01      | 740-046565 | QD130193     | QSFP+-40G-SR4          |
| Xcvr 2   | REV 01      | 740-046565 | QD130196     | QSFP+-40G-SR4          |
| PIC 3    |             | BUILTIN    | BUILTIN      | 3X40GE QSFPP           |
| Xcvr 0   | REV 01      | 740-046565 | QD130191     | QSFP+-40G-SR4          |
| Xcvr 1   | REV 01      | 740-046565 | QD130198     | QSFP+-40G-SR4          |
| Xcvr 2   | REV 01      | 740-046565 | QD130192     | QSFP+-40G-SR4          |
| WAN MEZZ | REV 09      | 750-049136 | CABN0411     | MPC5E 24XGE OTN Mezz   |
| FPC 19   | REV 39      | 750-045715 | CACD1908     | MPC5E 3D Q 24XGE+6XLGE |
| CPU      | REV 09      | 711-045719 | CACD1820     | RMP C PMB              |
| PIC 0    |             | BUILTIN    | BUILTIN      | 12X10GE SFPP OTN       |
| Xcvr 0   | REV 01      | 740-021308 | AQA0EXJ      | SFP+-10G-SR            |
| Xcvr 1   | REV 01      | 740-021308 | AQGOM6D      | SFP+-10G-SR            |
| Xcvr 2   | REV 01      | 740-021308 | AQG0LW7      | SFP+-10G-SR            |
| Xcvr 3   | REV 01      | 740-021308 | AQA0JKB      | SFP+-10G-SR            |
| Xcvr 4   | REV 01      | 740-021308 | AQGOMTM      | SFP+-10G-SR            |
| Xcvr 5   | REV 01      | 740-021308 | AQA07NE      | SFP+-10G-SR            |
| Xcvr 6   | REV 01      | 740-021308 | AQGOM41      | SFP+-10G-SR            |
| Xcvr 7   | REV 01      | 740-021308 | AQGOMU7      | SFP+-10G-SR            |

|            |        |            |          |                        |
|------------|--------|------------|----------|------------------------|
| Xcvr 8     | REV 01 | 740-021308 | AQGOMUG  | SFP+-10G-SR            |
| Xcvr 9     | REV 01 | 740-021308 | AQGOMMX  | SFP+-10G-SR            |
| Xcvr 10    | REV 01 | 740-021308 | AQGOM5K  | SFP+-10G-SR            |
| Xcvr 11    | REV 01 | 740-021308 | AQGOVLVZ | SFP+-10G-SR            |
| PIC 1      |        | BUILTIN    | BUILTIN  | 12X10GE SFPP OTN       |
| PIC 2      |        | BUILTIN    | BUILTIN  | 3X40GE QSFP            |
| PIC 3      |        | BUILTIN    | BUILTIN  | 3X40GE QSFP            |
| Xcvr 0     | REV 01 | 740-046565 | QD130242 | QSFP+-40G-SR4          |
| Xcvr 1     | REV 01 | 740-046565 | QD130245 | QSFP+-40G-SR4          |
| Xcvr 2     | REV 01 | 740-046565 | QD130613 | QSFP+-40G-SR4          |
| WAN MEZZ   | REV 09 | 750-049136 | CABN0418 | MPC5E 24XGE OTN Mezz   |
| ADC 0      | REV 17 | 750-043596 | ABCD5378 | Adapter Card           |
| ADC 1      | REV 17 | 750-043596 | ABCD5465 | Adapter Card           |
| ADC 2      | REV 17 | 750-043596 | ABCD5431 | Adapter Card           |
| ADC 3      | REV 17 | 750-043596 | ABCD5356 | Adapter Card           |
| ADC 4      | REV 02 | 750-043596 | ZW1545   | Adapter Card           |
| ADC 5      | REV 17 | 750-043596 | ABCD5517 | Adapter Card           |
| ADC 18     | REV 17 | 750-043596 | ABCD5535 | Adapter Card           |
| ADC 19     | REV 01 | 750-043596 | ZV4127   | Adapter Card           |
| Fan Tray 0 | REV 06 | 760-046960 | ACAY0791 | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 06 | 760-046960 | ACAY0788 | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 06 | 760-046960 | ACAY0755 | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 06 | 760-046960 | ACAY0441 | 172mm FanTray - 6 Fans |

#### show chassis hardware detail (MX2020 Router with MPC5EQ and MPC6E)

```
user@host>show chassis hardware detail
```

Hardware inventory:

| Item       | Version | Part number | Serial number | Description          |
|------------|---------|-------------|---------------|----------------------|
| Chassis    |         |             | JN120BADBAFJ  | MX2020               |
| Midplane   |         |             |               | Lower Backplane      |
| Midplane 1 | REV 04  | 711-032386  | ABAB9399      | Upper Backplane      |
| PMP 1      | REV 05  | 711-032428  | ACAJ2541      | Upper Power Midplane |
| PMP 0      | REV 04  | 711-032426  | ACAJ2194      | Lower Power Midplane |
| FPM Board  | REV 13  | 760-040242  | ABCA8835      | Front Panel Display  |
| PSM 0      | REV 01  | 740-050037  | 1EDB32403L5   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 1      | REV 01  | 740-050037  | 1EDB32403L3   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 2      | REV 01  | 740-050037  | 1EDB32403KM   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 3      | REV 01  | 740-050037  | 1EDB3130079   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 4      | REV 01  | 740-050037  | 1EDB3130077   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 5      | REV 01  | 740-050037  | 1EDB3130020   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 6      | REV 01  | 740-050037  | 1EDB313009S   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 7      | REV 01  | 740-050037  | 1EDB313008E   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 8      | REV 01  | 740-050037  | 1EDB3130063   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 12     | REV 01  | 740-050037  | 1EDB3130026   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 13     | REV 01  | 740-050037  | 1EDB3130074   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 14     | REV 01  | 740-050037  | 1EDB313009D   | DC 52V Power Supply  |
| Module     |         |             |               |                      |
| PSM 15     | REV 01  | 740-050037  | 1EDB3130024   | DC 52V Power Supply  |
| Module     |         |             |               |                      |

|                  |                                                      |            |                      |                        |
|------------------|------------------------------------------------------|------------|----------------------|------------------------|
| PSM 16 Module    | REV 01                                               | 740-050037 | 1EDB3130054          | DC 52V Power Supply    |
| PSM 17 Module    | REV 01                                               | 740-050037 | 1EDB3130080          | DC 52V Power Supply    |
| PDM 0            | REV 03                                               | 740-045234 | 1EGA3170144          | DC Power Dist Module   |
| PDM 1            | REV 03                                               | 740-045234 | 1EGA3170158          | DC Power Dist Module   |
| PDM 2            | REV 03                                               | 740-045234 | 1EGA3170182          | DC Power Dist Module   |
| PDM 3            | REV 03                                               | 740-045234 | 1EGA3170207          | DC Power Dist Module   |
| Routing Engine 0 | REV 02                                               | 740-041821 | 9009112112           | RE-S-1800x4            |
| ad0 3998 MB      | Virtium - TuffDrive                                  |            | VCF P1T0200274310822 | 113 Compact Flash      |
| ad1 30533 MB     | UGB94BPH32H0S1-KCI                                   |            | 11000031656          | Disk 1                 |
| usb0 (addr 1)    | EHCI root hub 0                                      |            | Intel                | uhub0                  |
| usb0 (addr 2)    | product 0x0020 32                                    |            | vendor 0x8087        | uhub1                  |
| DIMM 0           | SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80 |            |                      |                        |
| DIMM 1           | SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80 |            |                      |                        |
| DIMM 2           | SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80 |            |                      |                        |
| DIMM 3           | SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80 |            |                      |                        |
| Routing Engine 1 | REV 02                                               | 740-041821 | 9009112087           | RE-S-1800x4            |
| ad0 3998 MB      | Virtium - TuffDrive                                  |            | VCF P1T0200274310822 | 366 Compact Flash      |
| ad1 30533 MB     | UGB94BPH32H0S1-KCI                                   |            | 11000039979          | Disk 1                 |
| CB 0             | REV 23                                               | 750-040257 | CABA2295             | Control Board          |
| CB 1             | REV 23                                               | 750-040257 | CABE8379             | Control Board          |
| SPMB 0           |                                                      |            |                      |                        |
| SPMB 1           |                                                      |            |                      |                        |
| FPC 0 CPU        | REV 39                                               | 750-045715 | CACD1902             | MPC5E 3D Q 24XGE+6XLGE |
| FPC 1 CPU        | REV 11                                               | 750-045372 | CABK8112             | MPCE Type 3 3D         |
| FPC 2 CPU        | REV 17                                               | 750-037355 | CAAS5826             | MPC4E 3D 2CGE+8XGE     |
| FPC 3 CPU        | REV 05                                               | 750-044444 | CAAY9920             | MPCE Type 2 3D P       |
| FPC 4 CPU        | REV 18                                               | 750-046005 | CACH5661             | MPC5E 3D Q 2CGE+4XGE   |
| FPC 5 CPU        | REV 35                                               | 750-028467 | CAAR2623             | MPC 3D 16x 10GE        |
| FPC 9 CPU        | REV 30                                               | 750-044130 | ABCF5773             | MPC6E 3D               |
| FPC 10 CPU       | REV 36                                               | 750-044130 | ABCS8602             | MPC6E 3D               |
| FPC 17 CPU       | REV 28                                               | 750-044130 | ABBZ3873             | MPC6E 3D               |
| FPC 18 CPU       | REV 39                                               | 750-045715 | CACD1910             | MPC5E 3D Q 24XGE+6XLGE |
| FPC 19 CPU       | REV 39                                               | 750-045715 | CACD1908             | MPC5E 3D Q 24XGE+6XLGE |
| Fan Tray 0       | REV 06                                               | 760-046960 | ACAY0791             | 172mm FanTray - 6 Fans |
| Fan Tray 1       | REV 06                                               | 760-046960 | ACAY0788             | 172mm FanTray - 6 Fans |
| Fan Tray 2       | REV 06                                               | 760-046960 | ACAY0755             | 172mm FanTray - 6 Fans |
| Fan Tray 3       | REV 06                                               | 760-046960 | ACAY0441             | 172mm FanTray - 6 Fans |

#### show chassis hardware extensive (MX2020 Router with MPC5EQ and MPC6E)

```

user@host> show chassis hardware extensive
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Jedec Code:   0x7fb0          EEPROM Version: 0x02
S/N:          JN120BADBAFJ
Assembly ID:  0x0557          Assembly Version: 00.00
Date:         00-00-0000      Assembly Flags:  0x00

```

```

ID: MX2020
Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 05 57 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x20: 4a 4e 31 32 30 42 41 44 42 41 46 4a 00 00 00 00
  Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane          REV 51    750-040240    ABAB9243          Lower Backplane
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:          750-040240      S/N:          ABAB9243
Assembly ID:   0x0b22          Assembly Version: 01.51
Date:         05-30-2013      Assembly Flags: 0x00
Version:      REV 51          CLEI Code:     IPMU710ARA
ID: Lower Backplane          FRU Model Number: CHAS-BP-MX2020-S
Board Information Record:
  Address 0x00: ad 01 10 00 4c 96 14 72 30 08 ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 22 01 33 52 45 56 20 35 31 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 30 32 34 30 00 00
  Address 0x20: 53 2f 4e 20 41 42 41 42 39 32 34 33 00 1e 05 07
  Address 0x30: dd ff ff ff ad 01 10 00 4c 96 14 72 30 08 ff ff
  Address 0x40: ff ff ff ff 01 49 50 4d 55 37 31 30 41 52 41 43
  Address 0x50: 48 41 53 2d 42 50 2d 4d 58 32 30 32 30 2d 53 00
  Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff d3 ff ff ff ff ff ff ff ff ff ff ff ff
Midplane 1        REV 04    711-032386    ABAB9399          Upper Backplane
Jedec Code:    0x7fb0          EEPROM Version:    0x01
P/N:          711-032386      S/N:          ABAB9399
Assembly ID:   0x0b23          Assembly Version: 01.04
Date:         10-22-2012      Assembly Flags: 0x00
Version:      REV 04
ID: Upper Backplane
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 fe 0b 23 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 33 38 36 00 00
  Address 0x20: 53 2f 4e 20 41 42 41 42 39 33 39 39 00 16 0a 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
PMP 1            REV 05    711-032428    ACAJ2541          Upper Power Midplane
Jedec Code:    0x7fb0          EEPROM Version:    0x01
P/N:          711-032428      S/N:          ACAJ2541
Assembly ID:   0x045c          Assembly Version: 01.05
Date:         04-26-2013      Assembly Flags: 0x00
Version:      REV 05
ID: Upper Power Midplane
Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 5c 01 05 52 45 56 20 30 35 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 34 32 38 00 00
  Address 0x20: 53 2f 4e 20 41 43 41 4a 32 35 34 31 00 1a 04 07

```



```

Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
PMP 0          REV 04    711-032426    ACAJ2194          Lower Power Midplane
Jedec Code:    0x7fb0          EEPROM Version:    0x01
P/N:           711-032426      S/N:             ACAJ2194
Assembly ID:   0x045d          Assembly Version: 01.04
Date:          01-29-2013      Assembly Flags:   0x00
Version:       REV 04
ID: Lower Power Midplane
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 04 5d 01 04 52 45 56 20 30 34 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 34 32 36 00 00
Address 0x20: 53 2f 4e 20 41 43 41 4a 32 31 39 34 00 1d 01 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Board      REV 13    760-040242    ABCA8835          Front Panel Display
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:           760-040242      S/N:             ABCA8835
Assembly ID:   0x0b24          Assembly Version: 01.13
Date:          04-13-2013      Assembly Flags:   0x00
Version:       REV 13          CLEI Code:        IPMYAE5JRA
ID: Front Panel Display      FRU Model Number: MX2020-CRAFT-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 24 01 0d 52 45 56 20 31 33 00 00
Address 0x10: 00 00 00 00 37 36 30 2d 30 34 30 32 34 32 00 00
Address 0x20: 53 2f 4e 20 41 42 43 41 38 38 33 35 00 0d 04 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 4d 59 41 45 35 4a 52 41 4d
Address 0x50: 58 32 30 32 30 2d 43 52 41 46 54 2d 53 00 00 00
Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 95 ff ff ff ff ff ff ff ff ff ff ff ff
PSM 0          REV 01    740-050037    1EDB32403L5      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:    0x02
P/N:           740-050037      S/N:             1EDB32403L5
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          06-21-2013      Assembly Flags:   0x00
Version:       REV 01          CLEI Code:        IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 34 30 33 4c 35 00 00 15 06 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 1          REV 01    740-050037    1EDB32403L3      DC 52V Power Supply

```

```

Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-050037          S/N: 1EDB32403L3
Assembly ID: 0x0478        Assembly Version: 01.01
Date: 06-21-2013          Assembly Flags: 0x00
Version: REV 01           CLEI Code: IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 34 30 33 4c 33 00 00 15 06 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 2          REV 01 740-050037 1EDB32403KM DC 52V Power Supply
Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-050037          S/N: 1EDB32403KM
Assembly ID: 0x0478        Assembly Version: 01.01
Date: 06-21-2013          Assembly Flags: 0x00
Version: REV 01           CLEI Code: IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 32 34 30 33 4b 4d 00 00 15 06 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 3          REV 01 740-050037 1EDB3130079 DC 52V Power Supply
Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-050037          S/N: 1EDB3130079
Assembly ID: 0x0478        Assembly Version: 01.01
Date: 05-16-2013          Assembly Flags: 0x00
Version: REV 01           CLEI Code: IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 37 39 00 00 10 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 4          REV 01 740-050037 1EDB3130077 DC 52V Power Supply
Module
Jedec Code: 0x7fb0          EEPROM Version: 0x02
P/N: 740-050037          S/N: 1EDB3130077
Assembly ID: 0x0478        Assembly Version: 01.01

```

```

Date:          05-17-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 37 37 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 5          REV 01  740-050037  1EDB3130020      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB3130020
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-16-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 32 30 00 00 10 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 6          REV 01  740-050037  1EDB313009S      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB313009S
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-17-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 39 53 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 7          REV 01  740-050037  1EDB313008E      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB313008E
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-17-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:         IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:

```

```

Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 38 45 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 8          REV 01  740-050037  1EDB3130063      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB3130063
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-17-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 36 33 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 12          REV 01  740-050037  1EDB3130026      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB3130026
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-16-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 32 36 00 00 10 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 13          REV 01  740-050037  1EDB3130074      DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version:  0x02
P/N:           740-050037      S/N:             1EDB3130074
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-17-2013      Assembly Flags:  0x00
Version:       REV 01          CLEI Code:       IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00

```

```

Address 0x20: 31 45 44 42 33 31 33 30 30 37 34 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 14          REV 01   740-050037   1EDB313009D   DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version: 0x02
P/N:           740-050037      S/N:            1EDB313009D
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-17-2013      Assembly Flags: 0x00
Version:       REV 01          CLEI Code:      IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 35 30 30 33 37 00 00
Address 0x20: 31 45 44 42 33 31 33 30 30 39 44 00 00 11 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 49 50 55 50 41 4b 52 4b 41 41 4d
Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 44 43 2d 53 00 00
Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff
Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 15          REV 01   740-050037   1EDB3130024   DC 52V Power Supply
Module
Jedec Code:    0x7fb0          EEPROM Version: 0x02
P/N:           740-050037      S/N:            1EDB3130024
Assembly ID:   0x0478          Assembly Version: 01.01
Date:          05-16-2013      Assembly Flags: 0x00
Version:       REV 01          CLEI Code:      IPUPAKRKAA
ID: DC 52V Power Supply Module FRU Model Number: MX2000-PSM-DC-S
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
...
```

### show chassis hardware models (MX2020 Routers with MPC5EQ and MPC6E)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
Midplane      REV 51   750-040240   ABAB9243      CHAS-BP-MX2020-S
FPM Board     REV 13   760-040242   ABCA8835      MX2020-CRAFT-S
PSM 0         REV 01   740-050037   1EDB32403L5   MX2000-PSM-DC-S
PSM 1         REV 01   740-050037   1EDB32403L3   MX2000-PSM-DC-S
PSM 2         REV 01   740-050037   1EDB32403KM   MX2000-PSM-DC-S
PSM 3         REV 01   740-050037   1EDB3130079   MX2000-PSM-DC-S
PSM 4         REV 01   740-050037   1EDB3130077   MX2000-PSM-DC-S
PSM 5         REV 01   740-050037   1EDB3130020   MX2000-PSM-DC-S
PSM 6         REV 01   740-050037   1EDB313009S   MX2000-PSM-DC-S
PSM 7         REV 01   740-050037   1EDB313008E   MX2000-PSM-DC-S
PSM 8         REV 01   740-050037   1EDB3130063   MX2000-PSM-DC-S
PSM 12        REV 01   740-050037   1EDB3130026   MX2000-PSM-DC-S
PSM 13        REV 01   740-050037   1EDB3130074   MX2000-PSM-DC-S
PSM 14        REV 01   740-050037   1EDB313009D   MX2000-PSM-DC-S
PSM 15        REV 01   740-050037   1EDB3130024   MX2000-PSM-DC-S
PSM 16        REV 01   740-050037   1EDB3130054   MX2000-PSM-DC-S
PSM 17        REV 01   740-050037   1EDB3130080   MX2000-PSM-DC-S
```

|                  |        |            |             |                    |
|------------------|--------|------------|-------------|--------------------|
| PDM 0            | REV 03 | 740-045234 | 1EGA3170144 | MX2000-PDM-DC-S    |
| PDM 1            | REV 03 | 740-045234 | 1EGA3170158 | MX2000-PDM-DC-S    |
| PDM 2            | REV 03 | 740-045234 | 1EGA3170182 | MX2000-PDM-DC-S    |
| PDM 3            | REV 03 | 740-045234 | 1EGA3170207 | MX2000-PDM-DC-S    |
| Routing Engine 0 | REV 02 | 740-041821 | 9009112112  | RE-MX2000-1800X4-S |
| Routing Engine 1 | REV 02 | 740-041821 | 9009112087  | RE-MX2000-1800X4-S |
| CB 0             | REV 23 | 750-040257 | CABA2295    | RE-MX2000-1800X4-S |
| CB 1             | REV 23 | 750-040257 | CABE8379    | RE-MX2000-1800X4-S |
| SFB 0            | REV 06 | 711-044466 | ABCD5001    | MX2000-SFB-S       |
| SFB 1            | REV 06 | 711-044466 | ABCD5034    | MX2000-SFB-S       |
| SFB 2            | REV 06 | 711-044466 | ABCH3899    | MX2000-SFB-S       |
| SFB 3            | REV 06 | 711-044466 | ABCD5020    | MX2000-SFB-S       |
| SFB 4            | REV 06 | 711-044466 | ABCD4975    | MX2000-SFB-S       |
| SFB 5            | REV 06 | 711-044466 | ABCH3881    | MX2000-SFB-S       |
| SFB 6            | REV 06 | 711-044466 | ABCD5026    | MX2000-SFB-S       |
| SFB 7            | REV 06 | 711-044466 | ABCD5032    | MX2000-SFB-S       |
| FPC 0            | REV 39 | 750-045715 | CACD1902    | PROTO-ASSEMBLY     |
| FPC 1            | REV 11 | 750-045372 | CABK8112    | MX-MPC3E-3D        |
| FPC 2            | REV 17 | 750-037355 | CAAS5826    | MPC4E-3D-2CGE-8XGE |
| FPC 3            | REV 05 | 750-044444 | CAAY9920    | MX-MPC2E-3D-P      |
| FPC 4            | REV 18 | 750-046005 | CACH5661    | PROTO-ASSEMBLY     |
| FPC 5            | REV 35 | 750-028467 | CAAR2623    | MPC-3D-16XGE-SFPP  |
| FPC 9            | REV 30 | 750-044130 | ABCF5773    | PROTO-ASSEMBLY     |
| FPC 10           | REV 36 | 750-044130 | ABCS8602    | PROTO-ASSEMBLY     |
| FPC 17           | REV 28 | 750-044130 | ABBZ3873    | PROTO-ASSEMBLY     |
| FPC 18           | REV 39 | 750-045715 | CACD1910    | PROTO-ASSEMBLY     |
| FPC 19           | REV 39 | 750-045715 | CACD1908    | PROTO-ASSEMBLY     |
| ADC 0            | REV 17 | 750-043596 | ABCD5378    | MX2000-LC-ADAPTER  |
| ADC 1            | REV 17 | 750-043596 | ABCD5465    | MX2000-LC-ADAPTER  |
| ADC 2            | REV 17 | 750-043596 | ABCD5431    | MX2000-LC-ADAPTER  |
| ADC 3            | REV 17 | 750-043596 | ABCD5356    | MX2000-LC-ADAPTER  |
| ADC 4            | REV 02 | 750-043596 | ZW1545      | 750-043596         |
| ADC 5            | REV 17 | 750-043596 | ABCD5517    | MX2000-LC-ADAPTER  |
| ADC 18           | REV 17 | 750-043596 | ABCD5535    | MX2000-LC-ADAPTER  |
| ADC 19           | REV 01 | 750-043596 | ZV4127      | 750-043596         |
| Fan Tray 0       | REV 06 | 760-046960 | ACAY0791    | MX2000-FANTRAY-S   |
| Fan Tray 1       | REV 06 | 760-046960 | ACAY0788    | MX2000-FANTRAY-S   |
| Fan Tray 2       | REV 06 | 760-046960 | ACAY0755    | MX2000-FANTRAY-S   |
| Fan Tray 3       | REV 06 | 760-046960 | ACAY0441    | MX2000-FANTRAY-S   |

### show chassis hardware clei-models (MX2020 Router with MPC5EQ and MPC6E)

```
user@host> show chassis hardware clei-models
```

Hardware inventory:

| Item      | Version | Part number | CLEI code  | FRU model number |
|-----------|---------|-------------|------------|------------------|
| Midplane  | REV 51  | 750-040240  | IPMU710ARA | CHAS-BP-MX2020-S |
| FPM Board | REV 13  | 760-040242  | IPMYAE5JRA | MX2020-CRAFT-S   |
| PSM 0     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 1     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 2     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 3     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 4     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 5     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 6     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 7     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 8     | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 12    | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 13    | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 14    | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 15    | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |
| PSM 16    | REV 01  | 740-050037  | IPUPAKRKAA | MX2000-PSM-DC-S  |

|            |        |            |            |                    |
|------------|--------|------------|------------|--------------------|
| PSM 17     | REV 01 | 740-050037 | IPUPAKRKAA | MX2000-PSM-DC-S    |
| PDM 0      | REV 03 | 740-045234 | IPUPAJSKAA | MX2000-PDM-DC-S    |
| PDM 1      | REV 03 | 740-045234 | IPUPAJSKAA | MX2000-PDM-DC-S    |
| PDM 2      | REV 03 | 740-045234 | IPUPAJSKAA | MX2000-PDM-DC-S    |
| PDM 3      | REV 03 | 740-045234 | IPUPAJSKAA | MX2000-PDM-DC-S    |
| CB 0       | REV 23 | 750-040257 | IPUCBA7CTA | RE-MX2000-1800X4-S |
| CB 1       | REV 23 | 750-040257 | IPUCBA7CTA | RE-MX2000-1800X4-S |
| SFB 0      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 1      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 2      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 3      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 4      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 5      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 6      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| SFB 7      | REV 06 | 711-044466 | IPUCBA6CAA | MX2000-SFB-S       |
| FPC 0      | REV 39 | 750-045715 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 1      | REV 11 | 750-045372 | COUIBBNBAA | MX-MPC3E-3D        |
| FPC 2      | REV 17 | 750-037355 | IPU3A4DHAA | MPC4E-3D-2CGE-8XGE |
| FPC 3      | REV 05 | 750-044444 | COUIBBGBAA | MX-MPC2E-3D-P      |
| MIC 0      | REV 28 | 750-028387 | COUIA16BAA | MIC-3D-4XGE-XFP    |
| FPC 4      | REV 18 | 750-046005 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 5      | REV 35 | 750-028467 |            | MPC-3D-16XGE-SFPP  |
| FPC 9      | REV 30 | 750-044130 | PROTOXCLEI | PROTO-ASSEMBLY     |
| MIC 0      | REV 05 | 750-049457 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 10     | REV 36 | 750-044130 | PROTOXCLEI | PROTO-ASSEMBLY     |
| MIC 0      | REV 06 | 750-049979 | PROTOXCLEI | PROTO-ASSEMBLY     |
| MIC 1      | REV 12 | 750-050008 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 17     | REV 28 | 750-044130 | PROTOXCLEI | PROTO-ASSEMBLY     |
| MIC 1      | REV 03 | 750-050008 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 18     | REV 39 | 750-045715 | PROTOXCLEI | PROTO-ASSEMBLY     |
| FPC 19     | REV 39 | 750-045715 | PROTOXCLEI | PROTO-ASSEMBLY     |
| ADC 0      | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 1      | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 2      | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 3      | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 4      | REV 02 | 750-043596 | PROTOXCLEI | 750-043596         |
| ADC 5      | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 18     | REV 17 | 750-043596 | IPUCBA8CAA | MX2000-LC-ADAPTER  |
| ADC 19     | REV 01 | 750-043596 | PROTOXCLEI | 750-043596         |
| Fan Tray 0 | REV 06 | 760-046960 | IPUCBA5CAA | MX2000-FANTRAY-S   |
| Fan Tray 1 | REV 06 | 760-046960 | IPUCBA5CAA | MX2000-FANTRAY-S   |
| Fan Tray 2 | REV 06 | 760-046960 | IPUCBA5CAA | MX2000-FANTRAY-S   |
| Fan Tray 3 | REV 06 | 760-046960 | IPUCBA5CAA | MX2000-FANTRAY-S   |

#### show chassis hardware (MX Series routers with ATM MIC)

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item      | Version | Part number | Serial number | Description            |
|-----------|---------|-------------|---------------|------------------------|
| Chassis   |         |             | JN115736EAFc  | MX240                  |
| Midplane  | REV 07  | 760-021404  | ABAA5038      | MX240 Backplane        |
| FPM Board | REV 03  | 760-021392  | ABBA2758      | Front Panel Display    |
| PEM 0     | Rev 01  | 740-022697  | QCS0937C07K   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |
| PEM 1     | Rev 01  | 740-022697  | QCS0939C04X   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |
| PEM 2     | Rev 01  | 740-022697  | QCS0937C06B   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |
| PEM 3     | Rev 01  | 740-022697  | QCS0937C07U   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |

|                  |        |            |             |                    |
|------------------|--------|------------|-------------|--------------------|
| Routing Engine 0 | REV 12 | 740-013063 | 9009042291  | RE-S-2000          |
| Routing Engine 1 | REV 12 | 740-013063 | 9009042266  | RE-S-2000          |
| CB 0             | REV 06 | 710-021523 | ABBC1435    | MX SCB             |
| CB 1             | REV 06 | 710-021523 | ABBC1497    | MX SCB             |
| FPC 2            | REV 14 | 750-031088 | YH8446      | MPC Type 2 3D Q    |
| CPU              | REV 06 | 711-030884 | YH9612      | MPC PMB 2G         |
| MIC 0            |        |            |             |                    |
| MIC 1            | REV 10 | 750-036132 | ZP7062      | 2x0C12/8x0C3 CC-CE |
| PIC 2            |        | BUILTIN    | BUILTIN     | 2x0C12/8x0C3 CC-CE |
| Xcvr 0           |        | NON-JNPR   | 23393-00492 | UNKNOWN            |
| Xcvr 1           |        | NON-JNPR   | 23393-00500 | UNKNOWN            |
| Xcvr 2           |        | NON-JNPR   | 23393-00912 | UNKNOWN            |
| Xcvr 3           | REV 01 | 740-015638 | 22216-00575 | Load SFP           |
| Xcvr 4           | REV 01 | 740-015638 | 24145-00110 | Load SFP           |
| Xcvr 5           | REV 01 | 740-015638 | 24145-00016 | Load SFP           |
| Xcvr 6           | REV 01 | 740-015638 | 24145-00175 | Load SFP           |
| Xcvr 7           |        | NON-JNPR   | 23393-00627 | UNKNOWN            |
| QXM 0            | REV 05 | 711-028408 | YF4681      | MPC QXM            |
| QXM 1            | REV 05 | 711-028408 | YF4817      | MPC QXM            |
| Fan Tray 0       | REV 01 | 710-021113 | XL3645      | MX240 Fan Tray     |

#### show chassis hardware (MX240, MX480, MX960 routers with Application Services Modular Line Card)

```
user@host>show chassis hardware
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description               |
|------------------|---------|-------------|---------------|---------------------------|
| Chassis          |         |             | JN11D969BAFA  | MX960                     |
| Midplane         | REV 03  | 710-013698  | ACAA2362      | MX960 Backplane           |
| FPM Board        | REV 03  | 710-014974  | ZR0639        | Front Panel Display       |
| PDM              | Rev 03  | 740-013110  | QCS152250SX   | Power Distribution Module |
| PEM 0            | Rev 10  | 740-013683  | QCS1512718W   | DC Power Entry Module     |
| PEM 1            | Rev 10  | 740-013683  | QCS1512702Y   | DC Power Entry Module     |
| Routing Engine 0 | REV 15  | 740-013063  | 9012024667    | RE-S-2000                 |
| Routing Engine 1 | REV 15  | 740-013063  | 9012024649    | RE-S-2000                 |
| CB 0             | REV 14  | 750-031391  | ZJ7749        | Enhanced MX SCB           |
| CB 1             | REV 14  | 750-031391  | ZJ7750        | Enhanced MX SCB           |
| CB 2             | REV 14  | 750-031391  | ZY9233        | Enhanced MX SCB           |
| FPC 0            | REV 17  | 750-031089  | YR7434        | MPC Type 2 3D             |
| CPU              |         |             |               |                           |
| FPC 1            | REV 11  | 750-037207  | ZW9727        | AS-MCC                    |
| CPU              | REV 04  | 711-038173  | ZW4817        | AS-MCC-PMB                |
| MIC 0            | REV 01  | 750-037214  | ZH3764        | AS-MSC                    |
| PIC 0            |         | BUILTIN     | BUILTIN       | AS-MSC                    |
| MIC 1            | REV 01  | 711-028408  | JZ9200        | AS-MXC                    |
| PIC 2            |         | BUILTIN     | BUILTIN       | AS-MXC                    |
| FPC 4            | REV 30  | 750-028467  | ABBN0232      | MPC 3D 16x 10GE           |
| CPU              |         |             |               |                           |
| FPC 5            | REV 04  | 750-037207  | ZK9074        | AS-MCC                    |
| CPU              |         |             |               |                           |
| Fan Tray 0       | REV 05  | 740-014971  | VT5683        | Fan Tray                  |
| Fan Tray 1       | REV 05  | 740-014971  | VT5684        | Fan Tray                  |

#### show chassis hardware extensive (MX240, MX480, MX960 Routers with Application Services Modular Line Card)

```
user@host> show chassis hardware extensive
```

```
ID: AS-MCC                      FRU Model Number: 750-037207
Board Information Record:
```



```

Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 37 01 0b 52 45 56 20 31 31 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 30 37 00 00
Address 0x20: 53 2f 4e 20 5a 57 39 37 32 37 00 00 00 11 02 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
Address 0x50: 35 30 2d 30 33 37 32 30 37 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 31 31 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 5e ff ff ff ff ff ff ff ff ff ff ff ff
CPU          REV 04    711-038173    ZW4817          AS-MCC-PMB
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         711-038173      S/N:            ZW4817
Assembly ID: 0x0b38          Assembly Version: 01.04
Date:        12-30-2011      Assembly Flags:  0x00
Version:     REV 04
ID: AS-MCC-PMB
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 38 01 04 52 45 56 20 30 34 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 31 37 33 00 00
Address 0x20: 53 2f 4e 20 5a 57 34 38 31 37 00 00 00 1e 0c 07
Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 37
Address 0x50: 31 31 2d 30 33 38 31 37 33 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 30 34 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 60 00 00 00 00 00 00 00 00 00 00 00 00
MIC 0          REV 01    750-037214    ZH3764          AS-MS
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         750-037214      S/N:            ZH3764
Assembly ID: 0x0a44          Assembly Version: 01.01
Date:        07-04-2011      Assembly Flags:  0x00
Version:     REV 01
ID: AS-MS
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff I2C Hex Data:
Address 0x00: 7f b0 02 ff 0a 44 01 01 52 45 56 20 30 31 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 34 00 00
Address 0x20: 53 2f 4e 20 5a 48 33 37 36 34 00 00 00 04 07 07
Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff f6 c0 03 e1 bc 00 00 00 00 00 00 00 00
PIC 0          BUILTIN    BUILTIN          AS-MS
FPC 4          REV 30    750-028467    ABBN0232        MPC 3D 16x 10GE
Jedec Code:  0x7fb0          EEPROM Version:  0x01

```

### show chassis hardware (MX480 Router with MPC4E)

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item      | Version | Part number | Serial number | Description            |
|-----------|---------|-------------|---------------|------------------------|
| Chassis   |         |             | JN10FF57BAFB  | MX480                  |
| Midplane  | REV 05  | 750-047849  | Good          | MX480 Midplane         |
| FPM Board | REV 02  | 710-017254  | KG2066        | Front Panel Display    |
| PEM 0     | Rev 03  | 740-017330  | QCS081590BJ   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |
| PEM 1     | Rev 03  | 740-017330  | QCS0815908Z   | PS 1.2-1.7kW; 100-240V |
| AC in     |         |             |               |                        |
| PEM 2     | Rev 03  | 740-029970  | QCS1001U001   | PS 1.4-2.52kW; 90-264V |
| AC in     |         |             |               |                        |

|                  |             |            |            |                        |
|------------------|-------------|------------|------------|------------------------|
| Routing Engine 0 | REV 05      | 740-031116 | 9009089502 | RE-S-1800x4            |
| Routing Engine 1 | REV 05      | 740-031116 | 9009089624 | RE-S-1800x4            |
| CB 0             | REV 02      | 750-031391 | YE8506     | Enhanced MX SCB        |
| CB 1             | REV 14      | 750-031391 | ZK8265     | Enhanced MX SCB        |
| FPC 2            | REV 05      | 750-037358 | ZT0638     | MPC4E 3D 32XGE         |
| CPU              | REV 07      | 711-035209 | ZK3187     | HMPC PMB 2G            |
| PIC 0            |             | BUILTIN    | BUILTIN    | 8X10GE SFPP            |
| PIC 1            |             | BUILTIN    | BUILTIN    | 8X10GE SFPP            |
| PIC 2            |             | BUILTIN    | BUILTIN    | 8X10GE SFPP            |
| PIC 3            |             | BUILTIN    | BUILTIN    | 8X10GE SFPP            |
| FPC 3            | REV 06      | 750-037355 | CAAB1144   | MPC4E 3D 2CGE+8XGE     |
| CPU              | REV 08      | 711-035209 | CAAB1278   | HMPC PMB 2G            |
| PIC 0            |             | BUILTIN    | BUILTIN    | 4x10GE SFPP            |
| Xcvr 0           | REV 01      | 740-031980 | B11E01439  | SFP+-10G-SR            |
| Xcvr 1           | REV 01      | 740-031980 | B11D05809  | SFP+-10G-SR            |
| PIC 1            |             | BUILTIN    | BUILTIN    | 1X100GE CFP            |
| Xcvr 0           |             | NON-JNPR   | D5418      | UNKNOWN                |
| PIC 2            |             | BUILTIN    | BUILTIN    | 4x10GE SFPP            |
| PIC 3            |             | BUILTIN    | BUILTIN    | 1X100GE CFP            |
| Xcvr 0           |             | NON-JNPR   | X12J00362  | CFP-100G-SR10          |
| FPC 4            | REV 12.3.10 | 750-033205 | YR9445     | MPCE Type 3 3D         |
| CPU              |             |            |            |                        |
| Fan Tray         |             |            |            | Enhanced Left Fan Tray |

#### show chassis hardware (MX2020 Router with MPC4E)

```
user@host> show chassis hardware
```

| Hardware inventory: |         |             |               |                      |
|---------------------|---------|-------------|---------------|----------------------|
| Item                | Version | Part number | Serial number | Description          |
| Chassis             |         |             | JN11E188CAFJ  | MX2020               |
| Midplane            |         |             |               | Lower Backplane      |
| Midplane 1          | REV 04  | 711-032387  | ABAC7474      | Upper Backplane      |
| PMP 1               | REV 03  | 711-032428  | ACAJ1137      | Upper Power Midplane |
| PMP 0               | REV 03  | 711-032426  | ACAJ1016      | Lower Power Midplane |
| FPM Board           | REV 06  | 760-040242  | ABBT8832      | Front Panel Display  |
| PSM 3               | REV 0C  | 740-033727  | VK00255       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 4               | REV 0C  | 740-033727  | VJ00148       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 5               | REV 0C  | 740-033727  | VK00207       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 6               | REV 0C  | 740-033727  | VK00319       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 7               | REV 0C  | 740-033727  | VK00264       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 8               | REV 0B  | 740-033727  | VG00025       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 13              | REV 0C  | 740-033727  | VK00274       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 14              | REV 0C  | 740-033727  | VJ00167       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 15              | REV 0C  | 740-033727  | VK00299       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 16              | REV 0C  | 740-033727  | VK00213       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PSM 17              | REV 0C  | 740-033727  | VK00253       | DC 52V Power Supply  |
| Module              |         |             |               |                      |
| PDM 0               | REV 0B  | 740-038109  | VJ00040       | DC Power Dist Module |
| PDM 2               | REV 0B  | 740-038109  | VJ00025       | DC Power Dist Module |
| Routing Engine 0    | REV 02  | 740-041821  | 9009089735    | RE-S-1800x4          |
| Routing Engine 1    | REV 02  | 740-041821  | 9009089731    | RE-S-1800x4          |

|        |        |            |              |                       |
|--------|--------|------------|--------------|-----------------------|
| CB 0   | REV 04 | 750-040257 | ZT2846       | Control Board         |
| CB 1   | REV 04 | 750-040257 | ZT2877       | Control Board         |
| SPMB 0 | REV 01 | 711-041855 | ZS2282       | PMB Board             |
| SPMB 1 | REV 01 | 711-041855 | ZS2261       | PMB Board             |
| SFB 0  | REV 07 | 711-032385 | ZZ2582       | Switch Fabric Board   |
| SFB 1  | REV 04 | 711-032385 | ZV4229       | Switch Fabric Board   |
| SFB 2  | REV 07 | 711-032385 | CAAB4902     | Switch Fabric Board   |
| SFB 3  | REV 07 | 711-032385 | CAAB4891     | Switch Fabric Board   |
| SFB 4  | REV 07 | 711-032385 | CAAB4883     | Switch Fabric Board   |
| SFB 5  | REV 07 | 711-032385 | CAAB4889     | Switch Fabric Board   |
| SFB 6  | REV 06 | 711-032385 | ZV1818       | Switch Fabric Board   |
| SFB 7  | REV 07 | 711-032385 | CAAB4897     | Switch Fabric Board   |
| FPC 0  | REV 34 | 750-031090 | ZT9799       | MPC Type 2 3D EQ      |
| CPU    | REV 06 | 711-030884 | ZS1122       | MPC PMB 2G            |
| MIC 0  | REV 11 | 750-033535 | CAAD7674     | MIC-3D-10C192-XFP     |
| PIC 0  |        | BUILTIN    | BUILTIN      | MIC-3D-10C192-XFP     |
| Xcvr 0 | REV 01 | 740-014279 | 753019A00404 | XFP-OC192-SR          |
| MIC 1  | REV 14 | 750-031967 | ZM6103       | MIC-3D-80C30C12-40C48 |
| PIC 2  |        | BUILTIN    | BUILTIN      | MIC-3D-80C30C12-40C48 |
| Xcvr 0 | REV 01 | 740-011615 | PEF1AZP      | SFP-IR                |
| Xcvr 1 | REV 01 | 740-011615 | PEF1AZN      | SFP-IR                |
| Xcvr 2 | REV 01 | 740-021308 | ANAN8S       | SFP+-10G-SR           |
| QXM 0  | REV 06 | 711-028408 | ZT9339       | MPC QXM               |
| QXM 1  | REV 06 | 711-028408 | ZT9237       | MPC QXM               |
| FPC 9  | REV 34 | 750-031090 | ZT9770       | MPC Type 2 3D EQ      |
| CPU    | REV 06 | 711-030884 | ZS1302       | MPC PMB 2G            |
| MIC 0  | REV 24 | 750-028387 | YJ3950       | 3D 4x 10GE XFP        |
| PIC 0  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP           |
| Xcvr 0 |        | NON-JNPR   | T09M52516    | XFP-10G-SR            |
| Xcvr 1 |        | NON-JNPR   | CA49BK095    | XFP-10G-SR            |
| PIC 1  |        | BUILTIN    | BUILTIN      | 2x 10GE XFP           |
| Xcvr 0 | REV 02 | 740-014289 | C834XU01T    | XFP-10G-SR            |
| Xcvr 1 |        | NON-JNPR   | T09M52515    | XFP-10G-SR            |
| MIC 1  | REV 11 | 750-033535 | CAAD7681     | MIC-3D-10C192-XFP     |
| PIC 2  |        | BUILTIN    | BUILTIN      | MIC-3D-10C192-XFP     |
| Xcvr 0 | REV 01 | 740-014279 | KBQ02BE      | XFP-OC192-SR          |
| QXM 0  | REV 06 | 711-028408 | ZT9151       | MPC QXM               |
| QXM 1  | REV 06 | 711-028408 | ZT9116       | MPC QXM               |
| FPC 10 | REV 27 | 750-033205 | ZL6215       | MPCE Type 3 3D        |
| CPU    | REV 07 | 711-035209 | ZK9038       | HMPC PMB 2G           |
| MIC 0  | REV 18 | 750-028380 | YG6885       | 3D 2x 10GE XFP        |
| PIC 0  |        | BUILTIN    | BUILTIN      | 1x 10GE XFP           |
| Xcvr 0 | REV 01 | 740-014289 | C706XU0AG    | XFP-10G-SR            |
| PIC 1  |        | BUILTIN    | BUILTIN      | 1x 10GE XFP           |
| Xcvr 0 | REV 02 | 740-014289 | T08L84366    | XFP-10G-SR            |
| FPC 14 | REV 09 | 750-037355 | CAAF1534     | MPC4E 3D 2CGE+8XGE    |
| CPU    | REV 08 | 711-035209 | CAAB9879     | HMPC PMB 2G           |
| PIC 0  |        | BUILTIN    | BUILTIN      | 4x10GE SFPP           |
| Xcvr 0 | REV 01 | 740-021308 | 21T511100436 | SFP+-10G-SR           |
| Xcvr 1 | REV 01 | 740-031980 | AHPOGPM      | SFP+-10G-SR           |
| Xcvr 2 | REV 01 | 740-031980 | 123363A00032 | SFP+-10G-SR           |
| Xcvr 3 | REV 01 | 740-021308 | 19T511100477 | SFP+-10G-SR           |
| PIC 1  |        | BUILTIN    | BUILTIN      | 1X100GE CFP           |
| Xcvr 0 |        | NON-JNPR   | X12J00260    | CFP-100G-SR10         |
| PIC 2  |        | BUILTIN    | BUILTIN      | 4x10GE SFPP           |
| Xcvr 0 | REV 01 | 740-021308 | 21T511104086 | SFP+-10G-SR           |
| Xcvr 1 | REV 01 | 740-021308 | 21T511104627 | SFP+-10G-SR           |
| Xcvr 3 | REV 01 | 740-021308 | 21T511104644 | SFP+-10G-SR           |
| PIC 3  |        | BUILTIN    | BUILTIN      | 1X100GE CFP           |
| FPC 19 | REV 32 | 750-028467 | ZR2008       | MPC 3D 16x 10GE       |
| CPU    | REV 10 | 711-029089 | ZT6933       | AMPC PMB              |

|            |        |            |              |                        |
|------------|--------|------------|--------------|------------------------|
| PIC 0      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-021308 | 19T511100291 | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-021308 | AMH02VE      | SFP+-10G-SR            |
| PIC 1      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-021308 | 23T511102128 | SFP+-10G-SR            |
| PIC 2      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-021308 | AMS15PP      | SFP+-10G-SR            |
| PIC 3      |        | BUILTIN    | BUILTIN      | 4x 10GE(LAN) SFP+      |
| Xcvr 0     | REV 01 | 740-031980 | 123363A00716 | SFP+-10G-SR            |
| ADC 0      | REV 05 | 750-043596 | CAAC2072     | Adapter Card           |
| ADC 9      | REV 01 | 750-043596 | ZV4111       | Adapter Card           |
| ADC 10     | REV 05 | 750-043596 | CAAC2058     | Adapter Card           |
| ADC 14     | REV 02 | 750-043596 | ZW1561       | Adapter Card           |
| ADC 19     | REV 01 | 750-043596 | ZV4127       | Adapter Card           |
| Fan Tray 0 | REV 03 | 760-046960 | ACAY0124     | 172mm FanTray - 6 Fans |
| Fan Tray 1 | REV 2A | 760-046960 | ACAY0022     | 172mm FanTray - 6 Fans |
| Fan Tray 2 | REV 2A | 760-046960 | ACAY0023     | 172mm FanTray - 6 Fans |
| Fan Tray 3 | REV 2A | 760-046960 | ACAY0025     | 172mm FanTray - 6 Fans |

### show chassis hardware (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC)

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item           | Version | Part number | Serial number | Description           |
|----------------|---------|-------------|---------------|-----------------------|
| Chassis        |         |             | F3434         | MX80-P                |
| Midplane       | REV 01  | 711-044315  | ZK2681        | MX80-P                |
| PEM 0          | Rev 04  | 740-028288  | VE05267       | AC Power Entry Module |
| PEM 1          | Rev 04  | 740-028288  | VE05270       | AC Power Entry Module |
| Routing Engine |         | BUILTIN     | BUILTIN       | Routing Engine        |
| TFEB 0         |         | BUILTIN     | BUILTIN       | Forwarding Engine     |
| Processor      |         |             |               |                       |
| QXM 0          | REV 05  | 711-028408  | ZK0952        | MPC QXM               |
| FPC 0          |         | BUILTIN     | BUILTIN       | MPC BUILTIN           |
| MIC 0          |         | BUILTIN     | BUILTIN       | 4x 10GE XFP           |
| PIC 0          |         | BUILTIN     | BUILTIN       | 4x 10GE XFP           |
| FPC 1          |         | BUILTIN     | BUILTIN       | MPC BUILTIN           |
| MIC 0          | REV 02  | 750-049846  | CAAV2153      | 3D 20x 1GE(LAN)-E,SFP |
| PIC 0          |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) -E SFP   |
| Xcvr 0         | REV 01  | 740-011613  | AM0816S9B81   | SFP-SX                |
| Xcvr 1         | REV 02  | 740-011613  | AM0925SBLK7   | SFP-SX                |
| Xcvr 2         | REV 01  | 740-011613  | UAQ0005       | SFP-SX                |
| Xcvr 3         | REV 01  | 740-011613  | UAQ000C       | SFP-SX                |
| Xcvr 4         | REV 01  | 740-011613  | P9F195E       | SFP-SX                |
| Xcvr 5         | REV 01  | 740-011613  | UAQ0003       | SFP-SX                |
| Xcvr 6         | REV 01  | 740-031851  | AM1041SU1LD   | SFP-SX                |
| Xcvr 8         | REV 02  | 740-013111  | B101501       | SFP-T                 |
| PIC 1          |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) -E SFP   |
| Xcvr 0         | REV 01  | 740-011613  | PFM1ML7       | SFP-SX                |
| Xcvr 4         | REV 01  | 740-011613  | PE729P6       | SFP-SX                |
| Xcvr 6         | REV 02  | 740-011613  | AM1014SGC84   | SFP-SX                |
| Xcvr 9         | REV 01  | 740-011613  | AM0812S8UK3   | SFP-SX                |
| MIC 1          | REV 26  | 750-028392  | ZY0187        | 3D 20x 1GE(LAN) SFP   |
| PIC 2          |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) SFP      |
| Xcvr 0         | REV 01  | 740-011613  | P9F1AN9       | SFP-SX                |
| Xcvr 5         | REV 02  | 740-011613  | AM1003SFUF4   | SFP-SX                |
| Xcvr 9         | REV 01  | 740-031851  | AM1041SU1LM   | SFP-SX                |
| PIC 3          |         | BUILTIN     | BUILTIN       | 10x 1GE(LAN) SFP      |
| Xcvr 4         | REV 01  | 740-011613  | PAJ4MYT       | SFP-SX                |
| Xcvr 7         | +       | NON-JNPR    | XG32A024      | SFP-SX                |
| Xcvr 8         |         | NON-JNPR    | PFROV6J       | SFP-SX                |

```

Xcvr 9      REV 01  740-031851  AM1041SU02U      SFP-SX
Fan Tray

```

### show chassis hardware models (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
PEM 0         Rev 04    740-028288  VE05267       PWR-MX80-AC-S
PEM 1         Rev 04    740-028288  VE05270       PWR-MX80-AC-S
Routing Engine
TFEB 0                BUILTIN     BUILTIN
FPC 0                BUILTIN     BUILTIN
FPC 1                BUILTIN     BUILTIN
MIC 0          REV 02    750-049846  CAAV2153      MIC-3D-20GE-SFP-E
MIC 1          REV 26    750-028392  ZY0187        MIC-3D-20GE-SFP
Fan Tray
FANTRAY-MX80-S

```

### show chassis hardware (T320 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                19093       T320
Midplane              REV 04    710-004339  BC1436        T320 Backplane
FPM GBUS              REV 03    710-004461  BC1407        T320 FPM Board
FPM Display           REV 04    710-002897  BE0763        FPM Display
CIP                   REV 05    710-002895  BB2311        T Series CIP
PEM 0                 Rev 01    740-004359  NB12546       Power Entry Module
SCG 0                 REV 06    710-004455  AY4522        T320 Sonet
Clock Gen.
Routing Engine 0
CB 0                  REV 13    710-002728  BC1577        unknown
Control Board
CB 1                  REV 13    710-002728  BC1595        T Series
Control Board
FPC 1                 REV 09    710-007531  HS1572        FPC Type 2
CPU                   REV 15    710-001726  HR8763        FPC CPU
PIC 0                 REV 01    750-010618  CB5579        4x G/E SFP,
1000 BASE
SFP 0                 REV 01    740-007326  P5809Z1       SFP-SX
SFP 1                 REV 01    740-007326  P4Q10XU       SFP-SX
SFP 2                 NON-JNPR  RA45020031    SFP-SX
SFP 3                 NON-JNPR  RA45020032    SFP-SX
PIC 1                 REV 01    750-010618  CD9587        4x G/E SFP,
1000 BASE
SFP 0                 NON-JNPR  P5A08QZ       SFP-T
SFP 1                 REV 01    740-007326  P4Q133K       SFP-SX
SFP 2                 REV 01    740-007326  P5809YY       SFP-SX
SFP 3                 REV 01    740-007327  4C81704       SFP-LX
MMB 1                 REV 03    710-005555  HR9401        MMB-288mbit
PPB 0                 REV 04    710-003758  HR2886        PPB Type 2
FPC 2                 REV 07    710-005860  HP2392        FPC Type 1
CPU                   REV 14    710-001726  HP7797        FPC CPU
PIC 0                 REV 02    750-007643  HM0853        1x G/E QPP,
1000 BASE
SFP 0                 REV 01    740-007326  P11E9JJ       SFP-SX
MMB 1                 REV 02    710-005555  HN2379        MMB-288mbit
PPB 0                 REV 04    710-003758  HP8092        PPB Type 2
FPC 3                 REV 07    710-005860  HP2393        FPC Type 1

```

|           |        |            |         |                |
|-----------|--------|------------|---------|----------------|
| CPU       | REV 14 | 710-001726 | HP0968  | FPC CPU        |
| PIC 0     | REV 01 | 750-010240 | CB5363  | 1x G/E SFP,    |
| 1000 BASE |        |            |         |                |
| SFP 0     | REV 01 | 740-007326 | P4R0PNH | SFP-SX         |
| PIC 1     | REV 03 | 750-003034 | HD2832  | 4x OC-3 SONET, |
| SMIR      |        |            |         |                |
| MMB 1     | REV 02 | 710-005555 | HN6307  | MMB-288mbit    |
| PPB 0     | REV 04 | 710-003758 | HP5051  | PPB Type 2     |
| FPC 4     | REV 01 | 710-010845 | JD3872  | FPC Type 4     |
| CPU       | REV 02 | 710-011481 | JB6042  | FPC CPU        |
| 5         | REV 01 | 710-005802 | BC1566  | FPC Type 2     |
| CPU       | REV 09 | 710-001726 | AY4922  | FPC CPU        |
| PIC 0     | REV 02 | 750-008155 | BE2114  | 2x G/E QPP,    |
| 1000 BASE |        |            |         |                |
| SFP 0     | REV 01 | 740-007326 | P4R0PMQ | SFP-SX         |
| SFP 1     | REV 01 | 740-007326 | P4R0PN9 | SFP-SX         |
| PIC 1     | REV 01 | 750-008155 | BE2116  | 2x G/E QPP,    |
| 1000 BASE |        |            |         |                |
| SFP 0     | REV 01 | 740-007326 | P4R0PNZ | SFP-SX         |
| SFP 1     |        | NON-JNPR   | 2908    | SFP-T          |
| MMB 1     | REV 01 | 710-005555 | AZ2246  | MMB-288mbit    |
| PPB 0     | REV 03 | 710-003758 | AY4839  | PPB Type 2     |
| FPC 7     | REV 01 | 710-005803 | AZ2123  | FPC Type 3     |
| ...       |        |            |         |                |

### show chassis hardware (T640 Router)

```
user@host> show chassis hardware
```

| Hardware inventory: |         |             |               |                        |
|---------------------|---------|-------------|---------------|------------------------|
| Item                | Version | Part number | Serial number | Description            |
| Chassis             |         |             | 19182         | T640                   |
| Midplane            | REV 04  | 710-002726  | AX5608        | T640 Backplane         |
| FPM GBUS            | REV 02  | 710-002901  | HE3064        | T640 FPM Board         |
| FPM Display         | REV 02  | 710-002897  | HE7864        | FPM Display            |
| CIP                 | REV 05  | 710-002895  | HA5024        | T Series CIP           |
| PEM 0               | Rev 02  | 740-029522  | VH26235       | AC PEM 10kw US         |
| PEM 1               | Rev 02  | 740-029522  | VH26230       | AC PEM 10kw US         |
| SCG 0               | REV 03  | 710-003423  | HA4508        | T640 Sonet Clock Gen.  |
| Routing Engine 0    | REV 02  | 740-005022  | 210865700483  | RE-3.0 (RE-600)        |
| CB 0                | REV 01  | 710-002728  | HD3044        | T Series Control Board |
| FPC 2               | REV 04  | 710-001721  | HD5572        | FPC Type 3             |
| CPU                 | REV 06  | 710-001726  | HA4712        | FPC CPU                |
| PIC 1               | REV 03  | 750-009567  | HV2331        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-009898  | USC202R103    | XENPAK-SR              |
| PIC 2               | REV 03  | 750-009567  | HV2332        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-011268  | USC202R112    | XENPAK-ZR              |
| PIC 3               | REV 03  | 750-009567  | HX4416        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-012056  | 434TC004      | XENPAK-CX4             |
| PIC 4               | REV 03  | 750-009567  | HX4420        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-012058  | 434TC124      | XENPAK-LX4             |
| FPC 5               | REV 01  | 710-013553  | JE4839        | E2-FPC Type 1          |
| CPU                 | REV 01  | 710-013569  | JW9163        | FPC CPU                |
| PIC 0               | REV 01  | 750-009567  | HX4419        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-009898  | USC202RT05    | XENPAK-LR              |
| PIC 1               | REV 03  | 750-009567  | HN7426        | 1x 10GE(LAN),XENPAK    |
| SFP 0               | REV 01  | 740-009550  | 03L90051      | XENPAK-ER              |
| PIC 2               | REV 03  | 750-009467  | HT7423        | 1x 10GE(LAN),XENPAK    |
| SFP 0               |         | NON-JNPR    |               | UNKNOWN                |
| PIC 3               | REV 04  | 750-005100  | AY4850        | 1x 10GE(LAN),DWDM      |
| FPC 4               | REV 01  | 710-010845  | JD3872        | FPC Type 4             |
| CPU                 | REV 02  | 710-011481  | JB6042        | FPC CPU                |

|            |                       |
|------------|-----------------------|
| Fan Tray 0 | Front Top Fan Tray    |
| Fan Tray 1 | Front Bottom Fan Tray |
| Fan Tray 2 | Rear Fan Tray         |

### show chassis hardware models (T640 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  CLEI code  FRU model number
Midplane      REV 04    710-002726
FPM Display   REV 02    710-002897
CIP           REV 05    710-002895
PEM 0         Rev 01    740-002595
SCG 0         REV 04    710-003423
SCG 1         REV 04    710-003423
Routing Engine 0 REV 01    740-005022
Routing Engine 1 REV 07    740-005022
CB 0          REV 06    710-002726
CB 1          REV 06    710-002728
FPC 5         REV 05    710-007527
  PIC 0       REV 05    750-002510
  PIC 1       REV 05    750-001901
FPC 6         REV 03    710-001721
  PIC 1       REV 01    750-009553
SIB 4         REV 02    750-005486
Fan Tray 0
Fan Tray 1
Fan Tray 2
```

|                    |
|--------------------|
| CHAS-BP-T640-S     |
| CRAFT-T640-S       |
| CIP-L-T640-S       |
| PWR-T-DC-S         |
| SCG-T-S            |
| SCG-T-S            |
| RE-600-2048-S      |
| RE-600-2048-S      |
| CHAS-BP-T640-S     |
| CB-L-T-S           |
| T640-FPC2          |
| PB-2GE-SX          |
| PB-40C12-SON-SMIR  |
| T640-FPC3          |
| PC-40C48-SON-SFP   |
| SIB-I-T640-S       |
| FANTRAY-T-S        |
| FANTRAY-T-S        |
| FAN-REAR-TX-T640-S |

### show chassis hardware extensive (T640 Router)

```
user@host> show chassis hardware extensive
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Jedec Code:   0x7fb0          EEPROM Version: 0x01
P/N:          .....        S/N:          .....
Assembly ID:  0x0507          Assembly Version: 00.00
Date:         00-00-0000      Assembly Flags:  0x00
Version:      .....
ID: Gibson LCC Chassis
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 01 ff 05 07 00 00 00 00 00 00 00 00 00 00
Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane      REV 04    710-002726  AX5633
Jedec Code:   0x7fb0          EEPROM Version: 0x01
P/N:          710-002726.      S/N:          AX5633.
Assembly ID:  0x0127          Assembly Version: 01.04
Date:         06-27-2001      Assembly Flags:  0x00
Version:      REV 04.....
ID: Gibson Backplane
Board Information Record:
Address 0x00: ad 01 08 00 00 90 69 0e f8 00 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 01 27 01 04 52 45 56 20 30 34 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 30 32 37 32 36 00 00
```

```

Address 0x20: 53 2f 4e 20 41 58 35 36 33 33 00 00 00 1b 06 07
Address 0x30: d1 ff ff ff ad 01 08 00 00 90 69 0e f8 00 ff ff
Address 0x40: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM GBUS          REV 02    710-002901    HE3245
...
FPM Display      REV 02    710-002897    HA4873
...
CIP              REV 05    710-002895    HA4729
...
PEM 1            RevX02    740-002595    MD21815        Power Entry Module
...
SCG 0            REV 04    710-003423    HF6023
...
SCG 1            REV 04    710-003423    HF6061
...
Routing Engine 0 REV 01    740-005022    210865700292    RE-3.0
...
CB 0             REV 06    710-002728    HE3614
...
FPC 1            REV 01    710-002385    HE3009        FPC Type 1
...
                 REV 06    710-001726    HC0010

```

#### show chassis hardware (T4000 Router)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN1172F25AHA  T4000
Midplane      REV 01    710-027486    RC8355        T-series Backplane
FPM GBUS      REV 13    710-002901    BBAE0927      T640 FPM Board
FPM Display   REV 01    710-021387    EF6764        T1600 FPM Display
CIP           REV 06    710-002895    BBAD9210      T-series CIP
PEM 0         REV 01    740-036442    VA00016       Power Entry Module 6x60
SCG 0         REV 18    710-003423    BBAD7248      T640 Sonet Clock Gen.
SCG 1         REV 18    710-003423    BBAE3874      T640 Sonet Clock Gen.
Routing Engine 0 REV 05    740-026941    P737F-002248  RE-DUO-1800
Routing Engine 1 REV 06    740-026941    P737F-002653  RE-DUO-1800
CB 0          REV 09    710-022597    ED0295        LCC Control Board
CB 1          REV 09    710-022597    EA6050        LCC Control Board
FPC 0         REV 26    750-032819    EK1173        FPC Type 5-3D
CPU           REV 12    711-030686    EJ8584        SNG PMB
PIC 0         REV 07    750-034624    EF6837        12x10GE (LAN/WAN) SFPP
  Xcvr 0      REV 01    740-031980    123363A01145  SFP+-10G-SR
  Xcvr 1      REV 01    740-031980    123363A01147  SFP+-10G-SR
  Xcvr 2      REV 01    740-031980    AJJ01P3       SFP+-10G-SR
  Xcvr 3      REV 01    740-031980    B10M03256     SFP+-10G-SR
  Xcvr 4      REV 01    740-031980    AJJ01M2       SFP+-10G-SR
  Xcvr 5      REV 01    740-031980    123363A01137  SFP+-10G-SR
  Xcvr 6      REV 01    740-031980    AJJ01PN       SFP+-10G-SR
  Xcvr 7      REV 01    740-031980    AJJ01NW       SFP+-10G-SR
  Xcvr 8      REV 01    740-031980    123363A01139  SFP+-10G-SR
  Xcvr 9      REV 01    740-031980    AJJ01KE       SFP+-10G-SR
  Xcvr 10     REV 01    740-031980    123363A01336  SFP+-10G-SR
  Xcvr 11     REV 01    740-031980    B10M01325     SFP+-10G-SR
PIC 1         REV 07    750-034624    EF6800        12x10GE (LAN/WAN) SFPP
  Xcvr 0      REV 01    740-031980    AJJ01SA       SFP+-10G-SR
  Xcvr 1      REV 01    740-031980    AJJ01QZ       SFP+-10G-SR
  Xcvr 2      REV 01    740-031980    AJH0217       SFP+-10G-SR
  Xcvr 3      REV 01    740-031980    AJJ01TE       SFP+-10G-SR
  Xcvr 4      REV 01    740-031980    AJJ01KV       SFP+-10G-SR
  Xcvr 5      REV 01    740-031980    AJJ01MU       SFP+-10G-SR

```



|          |        |            |              |                        |
|----------|--------|------------|--------------|------------------------|
| Xcvr 6   | REV 01 | 740-031980 | AJJ01R0      | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | AJJ01TC      | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | AJJ0364      | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | AJD0GV3      | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | B10M03343    | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | AJJ01QJ      | SFP+-10G-SR            |
| LMB 0    | REV 05 | 711-034381 | EJ8490       | Type-0 LMB             |
| LMB 1    | REV 04 | 711-035774 | EJ8517       | Type-1 LMB             |
| LMB 2    | REV 05 | 711-034381 | EJ8489       | Type-0 LMB             |
| FPC 3    | REV 07 | 750-032819 | EG3637       | FPC Type 5-3D          |
| CPU      | REV 09 | 711-030686 | EG0150       | SNG PMB                |
| PIC 0    | REV 08 | 750-035293 | EF3657       | 1x100GE                |
| Xcvr 0   | REV 01 | 740-032210 | C22CQNJ      | CFP-100G-LR4           |
| PIC 1    | REV 10 | 750-034624 | BBAN4098     | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | B11J04902    | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | B11J04891    | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | AJJ01MX      | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | B11J04183    | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | B11J04894    | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | B11J04184    | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | B11J04897    | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | B11J04899    | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | AJJ01TV      | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | B11J04057    | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | AJJ01M4      | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | B11J04905    | SFP+-10G-SR            |
| LMB 0    | REV 04 | 711-034381 | EG1524       | Type-0 LMB             |
| LMB 1    | REV 03 | 711-035774 | EG0345       | Type-1 LMB             |
| LMB 2    | REV 04 | 711-034381 | EG1522       | Type-0 LMB             |
| FPC 5    | REV 03 | 710-033871 | BBAJ0768     | FPC Type 4-ES          |
| CPU      | REV 11 | 710-016744 | BBAH9342     | ST-PMB2                |
| PIC 0    | REV 09 | 750-029262 | EE6789       | 100GE                  |
| PIC 1    | REV 03 | 750-034781 | EE6655       | 100GE CFP              |
| Xcvr 0   | REV 01 | 740-032210 | J11A22334    | CFP-100G-LR4           |
| BRIDGE 0 | REV 03 | 711-029995 | EE6572       | 100GE Bridge Board     |
| MMB 0    | REV 07 | 710-025563 | BBAJ4657     | ST-MMB2                |
| MMB 1    | REV 07 | 710-025563 | BBAJ3073     | ST-MMB2                |
| FPC 6    | REV 05 | 750-010153 | EF4936       | FPC Type 5-3D          |
| CPU      | REV 06 | 711-030686 | EF4189       | SNG PMB                |
| PIC 0    | REV 10 | 750-034624 | BBAN4109     | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | B11J04895    | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | B11J04898    | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | B11J04021    | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | B11J04903    | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | B11J04311    | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | B11J04059    | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | B11J04016    | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | B11J04017    | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | B11J04887    | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | B11J04297    | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | B11J04893    | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | B11J04022    | SFP+-10G-SR            |
| PIC 1    | REV 02 | 750-034624 | EE3711       | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | AJH033X      | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | AJJ01N0      | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | AJJ01SV      | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | AJJ032L      | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | B10M01593    | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | AJD0FF1      | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | AJJ01NU      | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | 123363A01305 | SFP+-10G-SR            |

|            |        |            |           |                        |
|------------|--------|------------|-----------|------------------------|
| Xcvr 8     | REV 01 | 740-031980 | B10M00361 | SFP+-10G-SR            |
| Xcvr 9     | REV 01 | 740-031980 | AJJ01M7   | SFP+-10G-SR            |
| Xcvr 10    | REV 01 | 740-031980 | AJJ032X   | SFP+-10G-SR            |
| Xcvr 11    | REV 01 | 740-031980 | AJJ01PG   | SFP+-10G-SR            |
| LMB 0      | REV 04 | 711-034381 | EF3838    | Type-0 LMB             |
| LMB 1      | REV 03 | 711-035774 | EF3821    | Type-1 LMB             |
| LMB 2      | REV 04 | 711-034381 | EF3834    | Type-0 LMB             |
| SPMB 0     | REV 05 | 710-023321 | ED1990    | LCC Switch CPU         |
| SPMB 1     | REV 05 | 710-023321 | EA2768    | LCC Switch CPU         |
| SIB 0      | REV 02 | 711-036340 | EF8802    | SIB-HC-3D              |
| SIB 1      | REV 07 | 711-036340 | EG2286    | SIB-HC-3D              |
| SIB 2      | REV 07 | 711-036340 | EG2252    | SIB-HC-3D              |
| SIB 3      | REV 02 | 711-036340 | EF1358    | SIB-HC-3D              |
| SIB 4      | REV 02 | 711-036340 | EF8806    | SIB-HC-3D              |
| Fan Tray 0 |        |            |           | Front Top Fan Tray     |
| Fan Tray 1 |        |            |           | Front Bottom Fan Tray  |
| -- Rev 2   |        |            |           |                        |
| Fan Tray 2 |        |            |           | Rear Fan Tray -- Rev 3 |

### show chassis hardware (T4000 Router with 16-GB Line Card Chassis (LCC) Routing Engine)

```
user@host> show chassis hardware
```

Hardware inventory:

| Item             | Version | Part number | Serial number | Description             |
|------------------|---------|-------------|---------------|-------------------------|
| Chassis          |         |             | JN11BDF2CAHA  | T1600                   |
| Midplane         | REV 01  | 710-027486  | ACAJ0774      | T640 Backplane          |
| FPM GBUS         | REV 13  | 710-002901  | BBAL6812      | T640 FPM Board          |
| FPM Display      | REV 04  | 710-021387  | BBAP2679      | T1600 FPM Display       |
| CIP              | REV 06  | 710-002895  | BBAP4758      | T-series CIP            |
| PEM 0            | Rev 03  | 740-026384  | XF86421       | Power Entry Module 3x80 |
| PEM 1            | Rev 03  | 740-026384  | XF86429       | Power Entry Module 3x80 |
| SCG 0            | REV 18  | 710-003423  | BBAP1896      | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18  | 710-003423  | BBAN8659      | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 01  | 740-042243  | 737F-002238   | RE-DUO-1800-16G         |
| Routing Engine 1 | REV 01  | 740-042243  | 737F-002403   | RE-DUO-1800-16G         |
| CB 1             | REV 11  | 710-022597  | EK4526        | LCC Control Board       |
| CB 1             | REV 11  | 710-022597  | EK4527        | LCC Control Board       |
| FPC 0            | REV 05  | 710-033871  | EK5644        | FPC Type 4-ES           |
| CPU              | REV 11  | 710-016744  | EK3428        | ST-PMB2                 |
| PIC 0            | REV 20  | 750-017405  | EJ3041        | 4x 10GE (LAN/WAN) XFP   |
| PIC 1            | REV 17  | 750-026962  | EH7536        | 10x10GE(LAN/WAN) SFPP   |
| MMB 0            | REV 07  | 710-025563  | EK6039        | ST-MMB2                 |
| MMB 1            | REV 07  | 710-025563  | EK6086        | ST-MMB2                 |
| FPC 1            | REV 05  | 710-033871  | EK6583        | FPC Type 4-ES           |
| CPU              | REV 11  | 710-016744  | EK3401        | ST-PMB2                 |
| PIC 0            | REV 17  | 750-026962  | EJ8948        | 10x10GE(LAN/WAN) SFPP   |
| MMB 0            | REV 07  | 710-025563  | EK6202        | ST-MMB2                 |
| MMB 1            | REV 07  | 710-025563  | EK6112        | ST-MMB2                 |
| SPMB 1           | REV 05  | 710-023321  | EK4900        | LCC Switch CPU          |
| SIB 0            | REV 11  | 710-013074  | EK5958        | SIB-I8-SF               |
| SIB 1            | REV 11  | 710-013074  | EK4606        | SIB-I8-SF               |
| SIB 2            | REV 11  | 710-013074  | EK5971        | SIB-I8-SF               |
| SIB 3            | REV 11  | 710-013074  | EK4609        | SIB-I8-SF               |
| SIB 4            | REV 11  | 710-013074  | EK4602        | SIB-I8-SF               |
| Fan Tray 0       |         |             |               | Front Top Fan Tray      |
| Fan Tray 1       |         |             |               | Front Bottom Fan Tray   |
| Fan Tray 2       |         |             |               | Rear Fan Tray -- Rev 2  |

### show chassis hardware (T4000 Router with LSR FPC)

```
user@host> show chassis hardware
```

## Hardware inventory:

| Item    | Version | Part number | Serial number | Description            |
|---------|---------|-------------|---------------|------------------------|
| Chassis |         |             | JN1173A24AHA  | T4000                  |
| FPC 3   | REV     | 750-048373  | AN7797        | FPC Type 5-LSR         |
| CPU     | REV 10  | 711-030686  | AN6649        | SNG PMB                |
| PIC 0   | REV 07  | 750-034624  | EF6830        | 12x10GE (LAN/WAN) SFPP |

## show chassis hardware clei-models (T4000 Router)

user@host&gt; show chassis hardware clei-models

## Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number  |
|------------------|---------|-------------|------------|-------------------|
| Midplane         | REV 01  | 710-027486  | IPMJ700DRD | CHAS-BP-T1600-S   |
| FPM Display      | REV 01  | 710-021387  |            | CRAFT-T1600-S     |
| CIP              | REV 06  | 710-002895  |            | CIP-L-T640-S      |
| PEM 0            | REV 01  | 740-036442  | IPUPAG6KAA | PWR-T-6-60-DC     |
| SCG 0            | REV 18  | 710-003423  |            | SCG-T-S           |
| SCG 1            | REV 18  | 710-003423  |            | SCG-T-S           |
| Routing Engine 0 | REV 05  | 740-026941  |            | RE-DUO-C1800-8G-S |
| Routing Engine 1 | REV 06  | 740-026941  |            | RE-DUO-C1800-8G-S |
| CB 0             | REV 09  | 710-022597  |            | CB-LCC-S          |
| CB 1             | REV 09  | 710-022597  |            | CB-LCC-S          |
| FPC 3            |         |             |            |                   |
| PIC 0            | REV 08  | 750-035293  | XXXXXXXXBB | PF-1CGE-CFP       |
| PIC 1            | REV 10  | 750-034624  | XXXXXXXXCC | PF-12XGE-SFPP     |
| FPC 5            | REV 03  | 710-033871  | IPUCAMBCTD | T1600-FPC4-ES     |
| PIC 1            | REV 03  | 750-034781  | IPUIBKLMMA | PD-1CE-CFP-FPC4   |
| FPC 6            |         |             |            |                   |
| PIC 0            | REV 10  | 750-034624  | XXXXXXXXCC | PF-12XGE-SFPP     |
| Fan Tray 0       |         |             |            | FANTRAY-T-S       |
| Fan Tray 1       |         |             |            | FANTRAY-T4000-S   |
| Fan Tray 2       |         |             |            | FANTRAY-TXP-R-S   |

## show chassis hardware detail (T4000 Router)

user@host&gt; show chassis hardware detail

## Hardware inventory:

| Item             | Version  | Part number           | Serial number        | Description             |
|------------------|----------|-----------------------|----------------------|-------------------------|
| Chassis          |          |                       | JN1172F25AHA         | T4000                   |
| Midplane         | REV 01   | 710-027486            | RC8355               | T-series Backplane      |
| FPM GBUS         | REV 13   | 710-002901            | BBAE0927             | T640 FPM Board          |
| FPM Display      | REV 01   | 710-021387            | EF6764               | T1600 FPM Display       |
| CIP              | REV 06   | 710-002895            | BBAD9210             | T-series CIP            |
| PEM 0            | REV 01   | 740-036442            | VA00016              | Power Entry Module 6x60 |
| SCG 0            | REV 18   | 710-003423            | BBAD7248             | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18   | 710-003423            | BBAE3874             | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 05   | 740-026941            | P737F-002248         | RE-DUO-1800             |
| ad0              | 3823 MB  | SMART CF              | 2009121602A661576157 | Compact Flash           |
| ad1              | 59690 MB | STEC MACH-8 SSD       | STM000103FDB         | Disk 1                  |
| Routing Engine 1 | REV 06   | 740-026941            | P737F-002653         | RE-DUO-1800             |
| ad0              | 3823 MB  | SMART CF              | 201011150153F52CF52C | Compact Flash           |
| ad1              | 62720 MB | SMART Lite SATA Drive | 2010110900150A880A88 | Disk 1                  |
| CB 0             | REV 09   | 710-022597            | ED0295               | LCC Control Board       |
| CB 1             | REV 09   | 710-022597            | EA6050               | LCC Control Board       |
| FPC 0            | REV 26   | 750-032819            | EK1173               | FPC Type 5-3D           |
| CPU              | REV 12   | 711-030686            | EJ8584               | SNG PMB                 |
| PIC 0            | REV 07   | 750-034624            | EF6837               | 12x10GE (LAN/WAN) SFPP  |
| Xcvr 0           | REV 01   | 740-031980            | 123363A01145         | SFP+-10G-SR             |
| Xcvr 1           | REV 01   | 740-031980            | 123363A01147         | SFP+-10G-SR             |
| Xcvr 2           | REV 01   | 740-031980            | AJJ01P3              | SFP+-10G-SR             |
| Xcvr 3           | REV 01   | 740-031980            | B10M03256            | SFP+-10G-SR             |

|          |        |            |              |                        |
|----------|--------|------------|--------------|------------------------|
| Xcvr 4   | REV 01 | 740-031980 | AJJ01M2      | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | 123363A01137 | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | AJJ01PN      | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | AJJ01NW      | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | 123363A01139 | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | AJJ01KE      | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | 123363A01336 | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | B10M01325    | SFP+-10G-SR            |
| PIC 1    | REV 07 | 750-034624 | EF6800       | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | AJJ01SA      | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | AJJ01QZ      | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | AJH0217      | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | AJJ01TE      | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | AJJ01KV      | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | AJJ01MU      | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | AJJ01R0      | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | AJJ01TC      | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | AJJ0364      | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | AJD0GV3      | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | B10M03343    | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | AJJ01QJ      | SFP+-10G-SR            |
| LMB 0    | REV 05 | 711-034381 | EJ8490       | Type-0 LMB             |
| LMB 1    | REV 04 | 711-035774 | EJ8517       | Type-1 LMB             |
| LMB 2    | REV 05 | 711-034381 | EJ8489       | Type-0 LMB             |
| FPC 3    | REV 07 | 750-032819 | EG3637       | FPC Type 5-3D          |
| CPU      | REV 09 | 711-030686 | EG0150       | SNG PMB                |
| PIC 0    | REV 08 | 750-035293 | EF3657       | 1x100GE                |
| Xcvr 0   | REV 01 | 740-032210 | C22CQNJ      | CFP-100G-LR4           |
| PIC 1    | REV 10 | 750-034624 | BBAN4098     | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | B11J04902    | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | B11J04891    | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | AJJ01MX      | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | B11J04183    | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | B11J04894    | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | B11J04184    | SFP+-10G-SR            |
| Xcvr 6   | REV 01 | 740-031980 | B11J04897    | SFP+-10G-SR            |
| Xcvr 7   | REV 01 | 740-031980 | B11J04899    | SFP+-10G-SR            |
| Xcvr 8   | REV 01 | 740-031980 | AJJ01TV      | SFP+-10G-SR            |
| Xcvr 9   | REV 01 | 740-031980 | B11J04057    | SFP+-10G-SR            |
| Xcvr 10  | REV 01 | 740-031980 | AJJ01M4      | SFP+-10G-SR            |
| Xcvr 11  | REV 01 | 740-031980 | B11J04905    | SFP+-10G-SR            |
| LMB 0    | REV 04 | 711-034381 | EG1524       | Type-0 LMB             |
| LMB 1    | REV 03 | 711-035774 | EG0345       | Type-1 LMB             |
| LMB 2    | REV 04 | 711-034381 | EG1522       | Type-0 LMB             |
| FPC 5    | REV 03 | 710-033871 | BBAJ0768     | FPC Type 4-ES          |
| CPU      | REV 11 | 710-016744 | BBAH9342     | ST-PMB2                |
| PIC 0    | REV 09 | 750-029262 | EE6789       | 100GE                  |
| PIC 1    | REV 03 | 750-034781 | EE6655       | 100GE CFP              |
| Xcvr 0   | REV 01 | 740-032210 | J11A22334    | CFP-100G-LR4           |
| BRIDGE 0 | REV 03 | 711-029995 | EE6572       | 100GE Bridge Board     |
| MMB 0    | REV 07 | 710-025563 | BBAJ4657     | ST-MMB2                |
| MMB 1    | REV 07 | 710-025563 | BBAJ3073     | ST-MMB2                |
| FPC 6    | REV 05 | 750-010153 | EF4936       | FPC Type 5-3D          |
| CPU      | REV 06 | 711-030686 | EF4189       | SNG PMB                |
| PIC 0    | REV 10 | 750-034624 | BBAN4109     | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0   | REV 01 | 740-031980 | B11J04895    | SFP+-10G-SR            |
| Xcvr 1   | REV 01 | 740-031980 | B11J04898    | SFP+-10G-SR            |
| Xcvr 2   | REV 01 | 740-031980 | B11J04021    | SFP+-10G-SR            |
| Xcvr 3   | REV 01 | 740-031980 | B11J04903    | SFP+-10G-SR            |
| Xcvr 4   | REV 01 | 740-031980 | B11J04311    | SFP+-10G-SR            |
| Xcvr 5   | REV 01 | 740-031980 | B11J04059    | SFP+-10G-SR            |

|            |        |            |              |                        |
|------------|--------|------------|--------------|------------------------|
| Xcvr 6     | REV 01 | 740-031980 | B11J04016    | SFP+-10G-SR            |
| Xcvr 7     | REV 01 | 740-031980 | B11J04017    | SFP+-10G-SR            |
| Xcvr 8     | REV 01 | 740-031980 | B11J04887    | SFP+-10G-SR            |
| Xcvr 9     | REV 01 | 740-031980 | B11J04297    | SFP+-10G-SR            |
| Xcvr 10    | REV 01 | 740-031980 | B11J04893    | SFP+-10G-SR            |
| Xcvr 11    | REV 01 | 740-031980 | B11J04022    | SFP+-10G-SR            |
| PIC 1      | REV 02 | 750-034624 | EE3711       | 12x10GE (LAN/WAN) SFPP |
| Xcvr 0     | REV 01 | 740-031980 | AJH033X      | SFP+-10G-SR            |
| Xcvr 1     | REV 01 | 740-031980 | AJJ01N0      | SFP+-10G-SR            |
| Xcvr 2     | REV 01 | 740-031980 | AJJ01SV      | SFP+-10G-SR            |
| Xcvr 3     | REV 01 | 740-031980 | AJJ032L      | SFP+-10G-SR            |
| Xcvr 4     | REV 01 | 740-031980 | B10M01593    | SFP+-10G-SR            |
| Xcvr 5     | REV 01 | 740-031980 | AJD0FF1      | SFP+-10G-SR            |
| Xcvr 6     | REV 01 | 740-031980 | AJJ01NU      | SFP+-10G-SR            |
| Xcvr 7     | REV 01 | 740-031980 | 123363A01305 | SFP+-10G-SR            |
| Xcvr 8     | REV 01 | 740-031980 | B10M00361    | SFP+-10G-SR            |
| Xcvr 9     | REV 01 | 740-031980 | AJJ01M7      | SFP+-10G-SR            |
| Xcvr 10    | REV 01 | 740-031980 | AJJ032X      | SFP+-10G-SR            |
| Xcvr 11    | REV 01 | 740-031980 | AJJ01PG      | SFP+-10G-SR            |
| LMB 0      | REV 04 | 711-034381 | EF3838       | Type-0 LMB             |
| LMB 1      | REV 03 | 711-035774 | EF3821       | Type-1 LMB             |
| LMB 2      | REV 04 | 711-034381 | EF3834       | Type-0 LMB             |
| SPMB 0     | REV 05 | 710-023321 | ED1990       | LCC Switch CPU         |
| SPMB 1     | REV 05 | 710-023321 | EA2768       | LCC Switch CPU         |
| SIB 0      | REV 02 | 711-036340 | EF8802       | SIB-HC-3D              |
| SIB 1      | REV 07 | 711-036340 | EG2286       | SIB-HC-3D              |
| SIB 2      | REV 07 | 711-036340 | EG2252       | SIB-HC-3D              |
| SIB 3      | REV 02 | 711-036340 | EF1358       | SIB-HC-3D              |
| SIB 4      | REV 02 | 711-036340 | EF8806       | SIB-HC-3D              |
| Fan Tray 0 |        |            |              | Front Top Fan Tray     |
| Fan Tray 1 |        |            |              | Front Bottom Fan Tray  |
| -- Rev 2   |        |            |              |                        |
| Fan Tray 2 |        |            |              | Rear Fan Tray -- Rev 3 |

### show chassis hardware models (T4000 Router)

```
user@host> show chassis hardware models
```

Hardware inventory:

| Item             | Version | Part number | Serial number | FRU model number  |
|------------------|---------|-------------|---------------|-------------------|
| Midplane         | REV 01  | 710-027486  | RC8355        | CHAS-BP-T1600-S   |
| FPM Display      | REV 01  | 710-021387  | EF6764        | CRAFT-T1600-S     |
| CIP              | REV 06  | 710-002895  | BBAD9210      | CIP-L-T640-S      |
| PEM 0            | REV 01  | 740-036442  | VA00016       | PWR-T-6-60-DC     |
| SCG 0            | REV 18  | 710-003423  | BBAD7248      | SCG-T-S           |
| SCG 1            | REV 18  | 710-003423  | BBAE3874      | SCG-T-S           |
| Routing Engine 0 | REV 05  | 740-026941  | P737F-002248  | RE-DUO-C1800-8G-S |
| Routing Engine 1 | REV 06  | 740-026941  | P737F-002653  | RE-DUO-C1800-8G-S |
| CB 0             | REV 09  | 710-022597  | ED0295        | CB-LCC-S          |
| CB 1             | REV 09  | 710-022597  | EA6050        | CB-LCC-S          |
| FPC 3            |         |             |               |                   |
| PIC 0            | REV 08  | 750-035293  | EF3657        | PF-1CGE-CFP       |
| PIC 1            | REV 10  | 750-034624  | BBAN4098      | PF-12XGE-SFPP     |
| FPC 5            | REV 03  | 710-033871  | BBAJ0768      | T1600-FPC4-ES     |
| PIC 1            | REV 03  | 750-034781  | EE6655        | PD-1CE-CFP-FPC4   |
| FPC 6            |         |             |               |                   |
| PIC 0            | REV 10  | 750-034624  | BBAN4109      | PF-12XGE-SFPP     |
| Fan Tray 0       |         |             |               | FANTRAY-T-S       |
| Fan Tray 1       |         |             |               | FANTRAY-T4000-S   |
| Fan Tray 2       |         |             |               | FAN-REAR-TXP-LCC  |

**show chassis hardware lcc (TX Matrix Router)**

```
user@host> show chassis hardware lcc 0
lcc0-re0:
```

-----  
Hardware inventory:

| Item             | Version | Part number | Serial number | Description             |
|------------------|---------|-------------|---------------|-------------------------|
| Chassis          |         |             | 65751         | T640                    |
| Midplane         | REV 03  | 710-005608  | RA1408        | T640 Backplane          |
| FPM GBUS         | REV 09  | 710-002901  | RA2784        | T640 FPM Board          |
| FPM Display      | REV 05  | 710-002897  | RA2825        | FPM Display             |
| CIP              | REV 06  | 710-002895  | HT0684        | T Series CIP            |
| PEM 0            | Rev 11  | 740-002595  | PM18483       | Power Entry Module      |
| PEM 1            | Rev 11  | 740-002595  | qb13984       | Power Entry Module      |
| SCG 0            | REV 11  | 710-003423  | HT0022        | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 13  | 740-005022  | 210865700363  | RE-3.0 (RE-600)         |
| CB 0             | REV 03  | 710-007655  | HW1195        | Control Board (CB-T)    |
| FPC 1            | REV 05  | 710-007527  | HM3245        | FPC Type 2              |
| CPU              | REV 14  | 710-001726  | HM1084        | FPC CPU                 |
| PIC 0            | REV 02  | 750-007218  | AZ1112        | 2x OC-12 ATM2 IQ, SMIR  |
| PIC 1            | REV 02  | 750-007745  | HG3462        | 4x OC-3 SONET, SMIR     |
| PIC 2            | REV 14  | 750-001901  | BA5390        | 4x OC-12 SONET, SMIR    |
| PIC 3            | REV 09  | 750-008155  | HS3012        | 2x G/E IQ, 1000 BASE    |
| SFP 0            |         | NON-JNPR    | P1186TY       | SFP-S                   |
| SFP 1            | REV 01  | 740-007326  | P11WLTF       | SFP-SX                  |
| MMB 1            | REV 02  | 710-005555  | HL7514        | MMB-288mbit             |
| PPB 0            | REV 04  | 710-003758  | HM4405        | PPB Type 2              |
| PPB 1            | REV 04  | 710-003758  | AV1960        | PPB Type 2              |
| FPC 2            | REV 08  | 710-010154  | HZ3578        | E-FPC Type 3            |
| CPU              | REV 05  | 710-010169  | HZ3219        | FPC CPU-Enhanced        |
| PIC 0            | REV 02  | 750-009567  | HX2882        | 1x 10GE(LAN), XENPAK    |
| SFP 0            | REV 01  | 740-009898  | USC202U709    | XENPAK-LR               |
| PIC 1            | REV 03  | 750-003336  | HJ9954        | 4x OC-48 SONET, SMSR    |
| PIC 2            | REV 01  | 750-004535  | HC0235        | 1x OC-192 SM SR1        |
| PIC 3            | REV 07  | 750-007141  | HX1699        | 10x 1GE(LAN), 1000 BASE |
| SFP 0            | REV 01  | 740-007326  | 2441042       | SFP-SX                  |
| SFP 1            | REV 01  | 740-007326  | 2441027       | SFP-SX                  |
| MMB 0            | REV 03  | 710-010171  | HV2365        | MMB-5M3-288mbit         |
| MMB 1            | REV 03  | 710-010171  | HZ3888        | MMB-5M3-288mbit         |
| SPMB 0           | REV 09  | 710-003229  | HW5245        | T Series Switch CPU     |
| SIB 3            | REV 07  | 710-005781  | HR5927        | SIB-L8-F16              |
| B Board          | REV 06  | 710-005782  | HR5971        | SIB-L8-F16 (B)          |
| SIB 4            | REV 07  | 710-005781  | HR5903        | SIB-L8-F16              |
| B Board          | REV 06  | 710-005782  | HZ5275        | SIB-L8-F16 (B)          |

**show chassis hardware scc (TX Matrix Router)**

```
user@host> show chassis hardware scc
scc-re0:
```

-----  
Hardware inventory:

| Item             | Version | Part number | Serial number | Description        |
|------------------|---------|-------------|---------------|--------------------|
| Chassis          |         |             |               | TX Matrix          |
| Midplane         | REV 04  | 710-004396  | RB0014        | SCC Midplane       |
| FPM GBUS         | REV 04  | 710-004617  | HW9141        | SCC FPM Board      |
| FPM Display      | REV 04  | 710-004619  | HS5950        | SCC FPM            |
| CIP 0            | REV 01  | 710-010218  | HV9151        | SCC CIP            |
| CIP 1            | REV 01  | 710-010218  | HV9152        | SCC CIP            |
| PEM 1            | Rev 11  | 740-002595  | QB13977       | Power Entry Module |
| Routing Engine 0 | REV 05  | 740-008883  | P11123900153  | RE-4.0 (RE-1600)   |

|         |        |            |        |                       |
|---------|--------|------------|--------|-----------------------|
| CB 0    | REV 01 | 710-011709 | HR5964 | Control Board (CB-TX) |
| SPMB 0  | REV 09 | 710-003229 | HW5293 | T Series Switch CPU   |
| SIB 3   |        |            |        |                       |
| SIB 4   | REV 01 | 710-005839 | HW1177 | SIB-S8-F16            |
| B Board | REV 01 | 710-005840 | HW1202 | SIB-S8-F16 (B)        |

### show chassis hardware (T1600 Router)

```
user@host> show chassis hardware
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description              |
|------------------|---------|-------------|---------------|--------------------------|
| Chassis          |         |             | B2703         | T1600                    |
| Midplane         | REV 03  | 710-005608  | RC4137        | T640 Backplane           |
| FPM GBUS         | REV 10  | 710-002901  | DT7062        | T640 FPM Board           |
| FPM Display      | REV 05  | 710-002897  | DS3067        | FPM Display              |
| CIP              | REV 06  | 710-002895  | DT3386        | T-series CIP             |
| PEM 0            | Rev 07  | 740-017906  | UA26344       | Power Entry Module 3x80  |
| PEM 1            | Rev 18  | 740-002595  | UF38441       | Power Entry Module       |
| SCG 0            | REV 15  | 710-003423  | DV0941        | T640 Sonet Clock Gen.    |
| Routing Engine 0 | REV 08  | 740-014082  | 9009014502    | RE-A-2000                |
| Routing Engine 1 | REV 07  | 740-014082  | 9009009591    | RE-A-2000                |
| CB 0             | REV 05  | 710-007655  | JA9360        | Control Board (CB-T)     |
| CB 1             | REV 03  | 710-017707  | DT3251        | Control Board (CB-T)     |
| FPC 0            | REV 07  | 710-013558  | DR4253        | E2-FPC Type 2            |
| CPU              | REV 05  | 710-013563  | DS3902        | FPC CPU-Enhanced         |
| PIC 0            | REV 01  | 750-010618  | CB5446        | 4x G/E SFP, 1000 BASE    |
| Xcvr 0           | REV 01  | 740-011613  | P9F11CW       | SFP-SX                   |
| Xcvr 1           | REV 01  | 740-011613  | P9F15C2       | SFP-SX                   |
| Xcvr 2           | REV 01  | 740-011782  | PB94K0L       | SFP-SX                   |
| PIC 1            | REV 06  | 750-001900  | HB6399        | 1x OC-48 SONET, SMSR     |
| PIC 2            | REV 14  | 750-001901  | AP1092        | 4x OC-12 SONET, SMIR     |
| PIC 3            | REV 07  | 750-001900  | AR8275        | 1x OC-48 SONET, SMSR     |
| MMB 1            | REV 07  | 710-010171  | DS1524        | MMB-5M3-288mbit          |
| FPC 1            | REV 06  | 710-013553  | DL9067        | E2-FPC Type 1            |
| CPU              | REV 04  | 710-013563  | DM1685        | FPC CPU-Enhanced         |
| PIC 0            | REV 08  | 750-001072  | AB1688        | 1x G/E, 1000 BASE-SX     |
| PIC 1            | REV 10  | 750-012266  | JX5519        | 4x 1GE(LAN), IQ2         |
| Xcvr 0           | REV 01  | 740-011613  | AM0812S8UK6   | SFP-SX                   |
| Xcvr 2           | REV 01  | 740-011613  | AM0812S8UK1   | SFP-SX                   |
| Xcvr 3           | REV 01  | 740-011782  | P8N1YHG       | SFP-SX                   |
| PIC 2            | REV 22  | 750-005634  | DP0083        | 1x CHOC12 IQ SONET, SMIR |
| MMB 1            | REV 07  | 710-008923  | DN1862        | MMB 3M 288-bit           |
| FPC 2            | REV 01  | 710-005548  | HJ9899        | FPC Type 3               |
| CPU              | REV 06  | 710-001726  | HC0586        | FPC CPU                  |
| PIC 0            | REV 16  | 750-007141  | NC9660        | 10x 1GE(LAN), 1000 BASE  |
| Xcvr 0           | REV 01  | 740-011613  | AM0812S8XAR   | SFP-SX                   |
| Xcvr 1           | REV 01  | 740-011782  | P920E7B       | SFP-SX                   |
| Xcvr 2           | REV 01  | 740-011613  | AM0812S8XAU   | SFP-SX                   |
| Xcvr 4           | REV 01  | 740-011613  | AM0812S8XAK   | SFP-SX                   |
| Xcvr 5           | REV 01  | 740-011613  | AM0812S8XAA   | SFP-SX                   |
| Xcvr 6           | REV 01  | 740-011613  | PAJ4NKY       | SFP-SX                   |
| Xcvr 7           | REV 01  | 740-011613  | AM0812S8UJW   | SFP-SX                   |
| Xcvr 8           | REV 01  | 740-011782  | PB81X89       | SFP-SX                   |
| Xcvr 9           | REV 01  | 740-011613  | AM0812S8UJX   | SFP-SX                   |
| PIC 1            | REV 06  | 750-015217  | DK3280        | 8x 1GE(TYPE3), IQ2       |
| Xcvr 0           | REV 01  | 740-011782  | P8P0A3T       | SFP-SX                   |
| Xcvr 1           | REV 01  | 740-013111  | 5090002       | SFP-T                    |
| Xcvr 2           | REV 01  | 740-011613  | AM0814S93BQ   | SFP-SX                   |
| Xcvr 4           |         | NON-JNPR    | PDE0FAN       | SFP-SX                   |

|          |        |            |             |                         |
|----------|--------|------------|-------------|-------------------------|
| Xcvr 5   | REV 01 | 740-011782 | P8Q20XY     | SFP-SX                  |
| Xcvr 6   | REV 01 | 740-011613 | AM0812S8UJV | SFP-SX                  |
| Xcvr 7   | REV 01 | 740-011613 | AM0812S8UP7 | SFP-SX                  |
| PIC 2    | REV 05 | 750-004695 | HT4383      | 1x Tunnel               |
| PIC 3    | REV 17 | 750-009553 | RL0204      | 4x OC-48 SONET          |
| Xcvr 0   | REV 01 | 740-011785 | PDS3T23     | SFP-SR                  |
| Xcvr 1   | REV 01 | 740-011785 | P6Q0F3E     | SFP-SR                  |
| MMB 0    | REV 03 | 710-004047 | HD5843      | MMB-288mbit             |
| MMB 1    | REV 03 | 710-004047 | HE3208      | MMB-288mbit             |
| PPB 0    | REV 02 | 710-002845 | HA4524      | PPB Type 3              |
| PPB 1    | REV 02 | 710-002845 | HA4766      | PPB Type 3              |
| FPC 3    | REV 01 | 710-010154 | HR0863      | E-FPC Type 3            |
| CPU      | REV 01 | 710-010169 | HN3422      | FPC CPU-Enhanced        |
| PIC 0    | REV 07 | 750-012793 | WF5096      | 1x 10GE(LAN/WAN) IQ2    |
| Xcvr 0   |        | NON-JNPR   | M64294TP    | XFP-10G-LR              |
| PIC 1    | REV 25 | 750-007141 | DV2127      | 10x 1GE(LAN), 1000 BASE |
| Xcvr 0   | REV 01 | 740-011613 | PFA6LTJ     | SFP-SX                  |
| Xcvr 1   | REV 01 | 740-011782 | P9POXV4     | SFP-SX                  |
| Xcvr 2   | REV 01 | 740-011782 | P9M0TNX     | SFP-SX                  |
| Xcvr 4   | REV 01 | 740-011782 | P9B0TTP     | SFP-SX                  |
| Xcvr 5   |        | NON-JNPR   | PBS4LED     | SFP-SX                  |
| PIC 2    | REV 17 | 750-009553 | RL0212      | 4x OC-48 SONET          |
| Xcvr 0   | REV 01 | 740-011785 | PDS3T8G     | SFP-SR                  |
| PIC 3    | REV 32 | 750-003700 | DL1279      | 1x OC-192 12xMM VSR     |
| MMB 0    | REV 01 | 710-010171 | HR0821      | MMB-288mbit             |
| MMB 1    | REV 01 | 710-010171 | HR0818      | MMB-288mbit             |
| FPC 4    | REV 16 | 710-013037 | EB4919      | FPC Type 4-ES           |
| CPU      | REV 09 | 710-016744 | BBAA4382    | ST-PMB2                 |
| PIC 0    | REV 03 | 711-029996 | EB1569      | 100GE                   |
| PIC 1    | REV 05 | 711-029999 | EB9983      | 100GE CFP               |
| Xcvr 0   | REV 0  | 740-032210 | J10G80746   | CFP-100G-LR4            |
| BRIDGE 0 | REV 02 | 711-029995 | EB2235      | 100GE Bridge Board      |
| MMB 0    | REV 04 | 710-025563 | BBAA7112    | ST-MMB2                 |
| MMB 1    | REV 04 | 710-025563 | BBAA7149    | ST-MMB2                 |
| FPC 5    | REV 02 | 710-013037 | DE3407      | FPC Type 4-ES           |
| CPU      | REV 04 | 710-016744 | DA2124      | ST-PMB2                 |
| PIC 0    | REV 16 | 750-012518 | DF2554      | 4x OC-192 SONET XFP     |
| Xcvr 0   | REV 01 | 740-014279 | AA0745N1FX8 | XFP-OC192-SR            |
| Xcvr 1   | REV 01 | 740-014279 | AA0748N1HN5 | XFP-OC192-SR            |
| Xcvr 2   | REV 01 | 740-014279 | AA0748N1HT6 | XFP-OC192-SR            |
| Xcvr 3   | REV 01 | 740-014279 | AA0744N1EC9 | XFP-OC192-SR            |
| PIC 1    | REV 01 | 750-010850 | JA0329      | 1x OC-768 SONET SR      |
| MMB 0    | REV 04 | 710-016036 | DE9577      | ST-MMB2                 |
| MMB 1    | REV 04 | 710-016036 | DK4060      | ST-MMB2                 |
| FPC 6    | REV 14 | 710-013037 | DV1431      | FPC Type 4-ES           |
| CPU      | REV 09 | 710-016744 | DT9020      | ST-PMB2                 |
| PIC 0    | REV 11 | 750-017405 | DM6261      | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0   | REV 01 | 740-014289 | C701XU05Q   | XFP-10G-SR              |
| Xcvr 1   | REV 01 | 740-014279 | AA0748N1HPT | XFP-10G-LR              |
| Xcvr 2   | REV 01 | 740-014289 | T08E19189   | XFP-10G-SR              |
| Xcvr 3   | REV 01 | 740-014289 | C715XU058   | XFP-10G-SR              |
| PIC 1    | REV 13 | 750-017405 | DP8772      | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0   | REV 02 | 740-011571 | C850XJ037   | XFP-10G-SR              |
| Xcvr 1   | REV 02 | 740-014289 | C839XU0L9   | XFP-10G-SR              |
| Xcvr 2   | REV 02 | 740-014289 | C834XU05A   | XFP-10G-SR              |
| Xcvr 3   | REV 02 | 740-014289 | C810XU0CE   | XFP-10G-SR              |
| MMB 0    | REV 01 | 710-025563 | DT8454      | ST-MMB2                 |
| MMB 1    | REV 01 | 710-025563 | DT8366      | ST-MMB2                 |
| FPC 7    | REV 09 | 710-007529 | HZ7624      | FPC Type 3              |
| CPU      | REV 15 | 710-001726 | HZ1413      | FPC CPU                 |



|            |        |            |             |                        |
|------------|--------|------------|-------------|------------------------|
| PIC 0      | REV 10 | 750-012793 | DM5627      | 1x 10GE(LAN/WAN) IQ2   |
| Xcvr 0     | REV 02 | 740-011571 | C831XJ062   | XFP-10G-SR             |
| PIC 1      | REV 01 | 750-015217 | JT6762      | 8x 1GE(TYPE3), IQ2     |
| Xcvr 0     | REV 01 | 740-011782 | P8Q25JU     | SFP-SX                 |
| Xcvr 1     | REV 01 | 740-011782 | P9B0U0K     | SFP-SX                 |
| PIC 2      | REV 01 | 750-015217 | JS4268      | 8x 1GE(TYPE3), IQ2     |
| Xcvr 0     | REV 01 | 740-011613 | AM0812S8XBZ | SFP-SX                 |
| Xcvr 1     | REV 01 | 740-011613 | AM0812S8XAP | SFP-SX                 |
| Xcvr 2     | REV 01 | 740-011613 | AM0812S8XBY | SFP-SX                 |
| Xcvr 3     | REV 01 | 740-011613 | AM0812S8XBX | SFP-SX                 |
| Xcvr 4     | REV 01 | 740-011613 | P9F1652     | SFP-SX                 |
| Xcvr 5     | REV 01 | 740-011782 | P8Q21YC     | SFP-SX                 |
| Xcvr 6     | REV 01 | 740-011782 | P8Q27HQ     | SFP-SX                 |
| Xcvr 7     | REV 01 | 740-011613 | P8E2SSU     | SFP-SX                 |
| PIC 3      | REV 15 | 750-009450 | NB6790      | 1x OC-192 SM SR2       |
| MMB 0      | REV 03 | 710-005555 | HZ3450      | MMB-288mbit            |
| MMB 1      | REV 03 | 710-005555 | HZ3415      | MMB-288mbit            |
| PPB 0      | REV 04 | 710-002845 | HP0887      | PPB Type 3             |
| PPB 1      | REV 04 | 710-002845 | HW5255      | PPB Type 3             |
| SPMB 0     | REV 10 | 710-003229 | HX3699      | T-series Switch CPU    |
| SPMB 1     | REV 12 | 710-003229 | DT3091      | T-series Switch CPU    |
| SIB 0      | REV 07 | 710-013074 | DS4747      | SIB-I8-SF              |
| SIB 1      | REV 07 | 710-013074 | DS4942      | SIB-I8-SF              |
| SIB 2      | REV 07 | 710-013074 | DS4965      | SIB-I8-SF              |
| SIB 3      | REV 07 | 710-013074 | DS4990      | SIB-I8-SF              |
| SIB 4      | REV 07 | 710-013074 | DS4944      | SIB-I8-SF              |
| Fan Tray 0 |        |            |             | Front Top Fan Tray     |
| Fan Tray 1 |        |            |             | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |             | Rear Fan Tray -- Rev 2 |

### show chassis hardware (TX Matrix Plus Router)

```
user@host> show chassis hardware
sfc0-re0:
```

```
-----
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description        |
|------------------|---------|-------------|---------------|--------------------|
| Chassis          |         |             | JN113186EAHB  | TXP                |
| Midplane         | REV 05  | 710-022574  | TS3822        | SFC Midplane       |
| FPM Display      | REV 03  | 710-024027  | DW4701        | TXP FPM Display    |
| CIP 0            | REV 05  | 710-023792  | DW7998        | TXP CIP            |
| CIP 1            | REV 05  | 710-023792  | DW7999        | TXP CIP            |
| PEM 0            | Rev 04  | 740-027463  | UM26367       | Power Entry Module |
| PEM 1            | Rev 04  | 740-027463  | UM26346       | Power Entry Module |
| Routing Engine 0 | REV 06  | 740-026942  | 737A-1081     | RE-DUO-2600        |
| Routing Engine 1 | REV 06  | 740-026942  | 737A-1043     | RE-DUO-2600        |
| CB 0             | REV 05  | 710-022606  | DW4435        | SFC Control Board  |
| CB 1             | REV 09  | 710-022606  | DW6100        | SFC Control Board  |
| SPMB 0           |         | BUILTIN     |               | SFC Switch CPU     |
| SPMB 1           |         | BUILTIN     |               | SFC Switch CPU     |
| SIB F13 0        | REV 04  | 750-024564  | DW5764        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9053        | F13 SIB Mezz       |
| SIB F13 3        | REV 04  | 750-024564  | DW5785        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9030        | F13 SIB Mezz       |
| SIB F13 6        |         |             |               |                    |
| SIB F13 8        | REV 04  | 750-024564  | DW5752        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9051        | F13 SIB Mezz       |
| SIB F13 11       | REV 04  | 750-024564  | DW5782        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9058        | F13 SIB Mezz       |
| SIB F13 12       | REV 03  | 750-024564  | DT9466        | F13 SIB            |
| B Board          | REV 02  | 710-023431  | DT6556        | F13 SIB Mezz       |

|             |        |            |        |                |
|-------------|--------|------------|--------|----------------|
| SIB F2S 0/0 | REV 05 | 710-022603 | DW7898 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7625 | F2S SIB Mezz   |
| SIB F2S 0/2 | REV 05 | 710-022603 | DW7811 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7550 | F2S SIB Mezz   |
| SIB F2S 0/4 | REV 04 | 710-022603 | DW4873 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8509 | F2S SIB Mezz   |
| SIB F2S 0/6 | REV 04 | 710-022603 | DW4867 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8472 | F2S SIB Mezz   |
| SIB F2S 1/0 | REV 04 | 710-022603 | DW4871 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8497 | F2S SIB Mezz   |
| SIB F2S 1/2 | REV 05 | 710-022603 | DW7868 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7551 | F2S SIB Mezz   |
| SIB F2S 1/4 | REV 04 | 710-022603 | DW4854 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8496 | F2S SIB Mezz   |
| SIB F2S 1/6 | REV 05 | 710-022603 | DW7889 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7496 | F2S SIB Mezz   |
| SIB F2S 2/0 | REV 04 | 710-022603 | DW4852 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8498 | F2S SIB Mezz   |
| SIB F2S 2/2 | REV 04 | 710-022603 | DW4845 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8457 | F2S SIB Mezz   |
| SIB F2S 2/4 | REV 05 | 710-022603 | DW7802 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7562 | F2S SIB Mezz   |
| SIB F2S 2/6 | REV 04 | 710-022603 | DW4822 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8467 | F2S SIB Mezz   |
| SIB F2S 3/0 | REV 05 | 710-022603 | DW7815 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7518 | F2S SIB Mezz   |
| SIB F2S 3/2 | REV 03 | 710-022603 | DV0068 | F2S SIB        |
| B Board     | REV 03 | 710-023787 | DT9974 | F2S SIB Mezz   |
| SIB F2S 3/4 | REV 05 | 710-022603 | DW7874 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7601 | F2S SIB Mezz   |
| SIB F2S 3/6 | REV 03 | 710-022603 | DV0033 | F2S SIB        |
| B Board     | REV 03 | 710-023787 | DT9969 | F2S SIB Mezz   |
| SIB F2S 4/0 | REV 03 | 710-022603 | DV0043 | F2S SIB        |
| B Board     | REV 03 | 710-023787 | DT9948 | F2S SIB Mezz   |
| SIB F2S 4/2 | REV 05 | 710-022603 | DW5446 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7611 | F2S SIB Mezz   |
| SIB F2S 4/4 | REV 04 | 710-022603 | DW4826 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8458 | F2S SIB Mezz   |
| SIB F2S 4/6 | REV 03 | 710-022603 | DV0026 | F2S SIB        |
| B Board     | REV 03 | 710-023787 | DT9963 | F2S SIB Mezz   |
| Fan Tray 0  | REV 02 | 760-024497 | DR8290 | Front Fan Tray |
| Fan Tray 1  | REV 02 | 760-024497 | DR8293 | Front Fan Tray |
| Fan Tray 2  | REV 05 | 760-024502 | DR8280 | Rear Fan Tray  |
| Fan Tray 3  |        |            |        |                |
| Fan Tray 4  | REV 05 | 760-024502 | DR8276 | Rear Fan Tray  |
| Fan Tray 5  | REV 02 | 760-024502 | DP5643 | Rear Fan Tray  |

lcc0-re0:

-----  
Hardware inventory:

| Item             | Version | Part number | Serial number | Description              |
|------------------|---------|-------------|---------------|--------------------------|
| Chassis          |         |             | JN11036F8AHA  | T1600                    |
| Midplane         | REV 03  | 710-017247  | RC3799        | T-series Backplane       |
| FPM GBUS         | REV 10  | 710-002901  | DP7009        | T640 FPM Board           |
| FPM Display      | REV 01  | 710-021387  | DN7026        | T1600 FPM Display        |
| CIP              | REV 06  | 710-002895  | DP6024        | T-series CIP             |
| PEM 1            | Rev 02  | 740-023211  | WA50019       | Power Entry Module 4x60A |
| SCG 0            | REV 15  | 710-003423  | DR6757        | T640 Sonet Clock Gen.    |
| SCG 1            | REV 15  | 710-003423  | DS2225        | T640 Sonet Clock Gen.    |
| Routing Engine 0 | REV 01  | 740-026941  | 737F-1040     | RE-DUO-1800              |
| Routing Engine 1 | REV 01  | 740-026941  | 737F-1016     | RE-DUO-1800              |

|        |        |            |             |                          |
|--------|--------|------------|-------------|--------------------------|
| CB 0   | REV 06 | 710-022597 | DX4011      | LCC Control Board        |
| CB 1   | REV 06 | 710-022597 | DX4017      | LCC Control Board        |
| FPC 1  | REV 07 | 710-013035 | DN5847      | FPC Type 3-ES            |
| CPU    | REV 08 | 710-016744 | DP2570      | ST-PMB2                  |
| PIC 0  | REV 05 | 750-015217 | DB0418      | 8x 1GE(TYPE3), IQ2       |
| Xcvr 0 | REV 01 | 740-011782 | P8Q27ZG     | SFP-SX                   |
| Xcvr 1 |        | NON-JNPR   | PDA1U0D     | SFP-SX                   |
| Xcvr 2 | REV 01 | 740-011613 | P9F1ALW     | SFP-SX                   |
| Xcvr 3 | REV 01 | 740-011782 | PBA403V     | SFP-SX                   |
| Xcvr 4 |        | NON-JNPR   | PDE09DP     | SFP-SX                   |
| Xcvr 5 | REV 01 | 740-011782 | PCH2P4K     | SFP-SX                   |
| Xcvr 6 | REV 01 | 740-011782 | PB94K0F     | SFP-SX                   |
| Xcvr 7 | REV 01 | 740-011782 | PBA2R2A     | SFP-SX                   |
| PIC 1  | REV 03 | 750-004424 | HJ4020      | 1x 10GE(LAN), DWDM       |
| PIC 2  | REV 01 | 750-003336 | HG6073      | 4x OC-48 SONET, SMSR     |
| MMB 0  | REV 04 | 710-016036 | DP3401      | ST-MMB2                  |
| FPC 3  | REV 12 | 710-013037 | DR1169      | FPC Type 4-ES            |
| CPU    | REV 08 | 710-016744 | DP9429      | ST-PMB2                  |
| PIC 0  | REV 02 | 750-010850 | JA0332      | 1x OC-768 SONET SR       |
| MMB 0  | REV 04 | 710-016036 | DR0628      | ST-MMB2                  |
| MMB 1  | REV 04 | 710-016036 | DR0592      | ST-MMB2                  |
| FPC 4  | REV 05 | 710-021534 | DR7350      | FPC Type 1-ES            |
| CPU    | REV 08 | 710-016744 | DP8096      | ST-PMB2                  |
| PIC 0  | REV 04 | 750-014627 | DP9171      | 4x OC-3 1x OC-12 SFP     |
| Xcvr 0 | REV 02 | 740-011615 | PDE2RVR     | SFP-SR                   |
| PIC 1  | REV 22 | 750-005634 | DS5815      | 1x CHOC12 IQ SONET, SMIR |
| PIC 2  | REV 09 | 750-002911 | CF4539      | 4x F/E, 100 BASE-TX      |
| PIC 3  | REV 08 | 750-021652 | DR2827      | 1x CHOC12 IQE SONET      |
| Xcvr 0 |        | NON-JNPR   | 8           | UNKNOWN                  |
| MMB 0  | REV 04 | 710-016036 | DR0809      | ST-MMB2                  |
| FPC 5  | REV 07 | 710-007529 | HS5608      | FPC Type 3               |
| CPU    | REV 15 | 710-001726 | HX4351      | FPC CPU                  |
| PIC 0  | REV 14 | 750-009567 | WJ8961      | 1x 10GE(LAN), XENPAK     |
| Xcvr 0 | REV 01 | 740-013170 | J05K05961   | XENPAK-LR                |
| PIC 1  | REV 16 | 750-007141 | JJ8146      | 10x 1GE(LAN), 1000 BASE  |
| Xcvr 1 | REV 01 | 740-011613 | P9F117T     | SFP-SX                   |
| Xcvr 2 | REV 01 | 740-011782 | PBA2VCL     | SFP-SX                   |
| Xcvr 3 | REV 01 | 740-011782 | PB83DRB     | SFP-SX                   |
| Xcvr 4 | REV 01 | 740-011613 | AM0812S8UP8 | SFP-SX                   |
| PIC 2  | REV 12 | 750-009567 | WF3566      | 1x 10GE(LAN), XENPAK     |
| Xcvr 0 | REV 02 | 740-013170 | T07C94489   | XENPAK-LR                |
| MMB 0  | REV 03 | 710-005555 | HZ1907      | MMB-288mbit              |
| MMB 1  | REV 03 | 710-005555 | HW5283      | MMB-288mbit              |
| PPB 0  | REV 04 | 710-002845 | HZ7717      | PPB Type 3               |
| PPB 1  | REV 04 | 710-002845 | HS0110      | PPB Type 3               |
| FPC 6  | REV 07 | 710-013035 | DP7486      | FPC Type 3-ES            |
| CPU    | REV 08 | 710-016744 | DP2545      | ST-PMB2                  |
| PIC 0  | REV 09 | 750-009567 | NE6323      | 1x 10GE(LAN), XENPAK     |
| Xcvr 0 | REV 02 | 740-013170 | T09C71959   | XENPAK-LR                |
| PIC 1  | REV 06 | 750-015217 | DN4775      | 8x 1GE(TYPE3), IQ2       |
| Xcvr 0 | REV 01 | 740-011782 | P7E0T6M     | SFP-SX                   |
| Xcvr 1 | REV 01 | 740-011613 | AM0812S8XAY | SFP-SX                   |
| Xcvr 2 | REV 01 | 740-011782 | P7E0T6J     | SFP-SX                   |
| Xcvr 3 | REV 01 | 740-011782 | PCH2P7D     | SFP-SX                   |
| Xcvr 4 | REV 01 | 740-011782 | P9B0QYT     | SFP-SX                   |
| Xcvr 5 | REV 01 | 740-011613 | AM0812S8WQJ | SFP-SX                   |
| Xcvr 6 | REV 02 | 740-013111 | 9301220     | SFP-T                    |
| Xcvr 7 | REV 01 | 740-011782 | P9B0TZ5     | SFP-SX                   |
| PIC 2  | REV 06 | 750-015217 | DM6747      | 8x 1GE(TYPE3), IQ2       |

|            |        |            |             |                        |
|------------|--------|------------|-------------|------------------------|
| Xcvr 0     | REV 01 | 740-011613 | PAP0ZB2     | SFP-SX                 |
| Xcvr 1     | REV 01 | 740-013111 | 70191002    | SFP-T                  |
| Xcvr 6     | REV 01 | 740-011782 | PBA29H8     | SFP-SX                 |
| Xcvr 7     | REV 01 | 740-011613 | AM0812S8WQG | SFP-SX                 |
| MMB 0      | REV 04 | 710-016036 | DP3238      | ST-MMB2                |
| FPC 7      | REV 03 | 710-021540 | DV3154      | FPC Type 2-ES          |
| CPU        | REV 09 | 710-016744 | DT9053      | ST-PMB2                |
| PIC 0      | REV 13 | 750-001901 | HB4225      | 4x OC-12 SONET, SMIR   |
| PIC 1      | REV 05 | 750-001900 | AD3644      | 1x OC-48 SONET, SMSR   |
| PIC 2      | REV 10 | 750-008155 | HV0335      | 2x G/E IQ, 1000 BASE   |
| Xcvr 0     | REV 01 | 740-011782 | PCH2UKF     | SFP-SX                 |
| Xcvr 1     | REV 01 | 740-011782 | PCH2V19     | SFP-SX                 |
| PIC 3      | REV 03 | 750-014638 | JS9493      | 1x OC-48-12-3 SFP      |
| Xcvr 0     | REV 01 | 740-011785 | P6Q0ENK     | SFP-SR                 |
| MMB 0      | REV 05 | 710-016036 | DP3323      | ST-MMB2                |
| SPMB 0     | REV 04 | 710-023321 | DX3004      | LCC Switch CPU         |
| SPMB 1     | REV 04 | 710-023321 | DX3009      | LCC Switch CPU         |
| SIB 0      | REV 07 | 710-022594 | DW4195      | LCC SIB                |
| B Board    | REV 07 | 710-023185 | DW3930      | LCC SIB Mezz           |
| SIB 1      | REV 07 | 710-022594 | DW4179      | LCC SIB                |
| B Board    | REV 07 | 710-023185 | DW3919      | LCC SIB Mezz           |
| SIB 2      |        |            |             |                        |
| SIB 3      | REV 06 | 710-022594 | DT8251      | LCC SIB                |
| B Board    | REV 06 | 710-023185 | DT5792      | LCC SIB Mezz           |
| SIB 4      | REV 08 | 710-022594 | DW8014      | LCC SIB                |
| B Board    | REV 07 | 710-023185 | DW3917      | LCC SIB Mezz           |
| Fan Tray 0 |        |            |             | Front Top Fan Tray     |
| Fan Tray 1 |        |            |             | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |             | Rear Fan Tray -- Rev 3 |

lcc1-re0:

## Hardware inventory:

| Item             | Version | Part number | Serial number | Description              |
|------------------|---------|-------------|---------------|--------------------------|
| Chassis          |         |             | JN1102270AHA  | T1600                    |
| Midplane         | REV 04  | 710-017247  | RC5358        | T-series Backplane       |
| FPM GBUS         | REV 10  | 710-002901  | DS3443        | T640 FPM Board           |
| FPM Display      | REV 01  | 710-021387  | DS6411        | T1600 FPM Display        |
| CIP              | REV 06  | 710-002895  | DS4235        | T-series CIP             |
| PEM 0            | Rev 02  | 740-023211  | VM82438       | Power Entry Module 4x60A |
| SCG 0            | REV 15  | 710-003423  | DS6649        | T640 Sonet Clock Gen.    |
| SCG 1            | REV 15  | 710-003423  | DR6775        | T640 Sonet Clock Gen.    |
| Routing Engine 0 | REV 01  | 740-026941  | 737F-1083     | RE-DUO-1800              |
| Routing Engine 1 | REV 01  | 740-026941  | 737F-1104     | RE-DUO-1800              |
| CB 0             | REV 06  | 710-022597  | DW8542        | LCC Control Board        |
| CB 1             | REV 06  | 710-022597  | DW8530        | LCC Control Board        |
| FPC 0            | REV 02  | 710-010845  | JE2392        | FPC Type 4               |
| CPU              | REV 02  | 710-011481  | JF6820        | FPC CPU-Enhanced         |
| PIC 0            | REV 11  | 750-017405  | DP7259        | 4x 10GE (LAN/WAN) XFP    |
| Xcvr 0           | REV 01  | 740-014279  | AA0741N1C8T   | XFP-10G-LR               |
| Xcvr 1           | REV 01  | 740-014279  | AA0746N1GAM   | XFP-10G-LR               |
| Xcvr 2           | REV 01  | 740-014279  | AA0747N1H0B   | XFP-10G-LR               |
| Xcvr 3           | REV 01  | 740-014279  | AA0748N1HZ5   | XFP-10G-LR               |
| MMB 0            | REV 03  | 710-010842  | HY7601        | ST-MMB                   |
| FPC 1            | REV 16  | 710-013037  | BBAA7398      | FPC Type 4-ES            |
| CPU              | REV 09  | 710-016744  | BBAA2329      | ST-PMB2                  |
| PIC 0            | REV 03  | 711-029996  | EB1575        | 100GE                    |
| PIC 1            | REV 06  | 750-034781  | EB9980        | 100GE CFP                |
| MMB 0            | REV 04  | 710-025563  | BBAA5325      | ST-MMB2                  |
| MMB 1            | REV 04  | 710-025563  | BBAA5444      | ST-MMB2                  |
| FPC 2            | REV 16  | 710-013037  | BBAA7185      | FPC Type 4-ES            |

|          |        |            |             |                          |
|----------|--------|------------|-------------|--------------------------|
| CPU      | REV 09 | 710-016744 | BBAA3522    | ST-PMB2                  |
| PIC 0    | REV 03 | 711-029996 | EB1557      | 100GE                    |
| PIC 1    | REV 05 | 750-034781 | EB4660      | 100GE CFP                |
| Xcvr 0   | REV 0  | 740-032210 | J10F73666   | CFP-100G-LR4             |
| BRIDGE 0 | REV 02 | 711-029995 | EB2237      | 100GE Bridge Board       |
| MMB 0    | REV 04 | 710-025563 | BBAA5347    | ST-MMB2                  |
| MMB 1    | REV 04 | 710-025563 | BBAA5401    | ST-MMB2                  |
| FPC 3    | REV 10 | 710-021534 | DZ0941      | FPC Type 1-ES            |
| CPU      | REV 09 | 710-016744 | DY6364      | ST-PMB2                  |
| PIC 0    | REV 13 | 750-012266 | DK9192      | 4x 1GE(LAN), IQ2         |
| Xcvr 0   | REV 01 | 740-011613 | AM0812S8WVD | SFP-SX                   |
| Xcvr 1   |        | NON-JNPR   | PDD63Q4     | SFP-SX                   |
| Xcvr 2   |        | NON-JNPR   | PDE4G54     | SFP-SX                   |
| Xcvr 3   |        | NON-JNPR   | PD40MAG     | SFP-SX                   |
| PIC 1    | REV 01 | 750-007641 | HJ2003      | 1x G/E IQ, 1000 BASE     |
| Xcvr 0   | REV 01 | 740-011613 | AM0812S8WVG | SFP-SX                   |
| PIC 3    | REV 17 | 750-007444 | JB6873      | 1x CHSTM1 IQ SDH, SMIR   |
| MMB 0    | REV 04 | 710-025563 | DZ0281      | ST-MMB2                  |
| FPC 4    | REV 06 | 710-013035 | DK0614      | FPC Type 3-ES            |
| CPU      | REV 07 | 710-016744 | DK1616      | ST-PMB2                  |
| PIC 0    | REV 22 | 750-007141 | DM1870      | 10x 1GE(LAN), 1000 BASE  |
| Xcvr 0   | REV 01 | 740-011782 | PCL3UKW     | SFP-SX                   |
| Xcvr 1   | REV 01 | 740-011782 | P7E0T73     | SFP-SX                   |
| Xcvr 2   | REV 01 | 740-007326 | P4TOWLR     | SFP-SX                   |
| Xcvr 3   | REV 01 | 740-011782 | PAR1LRL     | SFP-SX                   |
| Xcvr 4   | REV 01 | 740-011782 | P9M0U3Z     | SFP-SX                   |
| Xcvr 5   | REV 01 | 740-011782 | P9M0U0C     | SFP-SX                   |
| Xcvr 6   | REV 01 | 740-011782 | P9M0TLG     | SFP-SX                   |
| Xcvr 7   | REV 01 | 740-011782 | P9M0U0F     | SFP-SX                   |
| Xcvr 8   | REV 01 | 740-011613 | PFA6LAP     | SFP-SX                   |
| Xcvr 9   | REV 01 | 740-011782 | PCH2P0U     | SFP-SX                   |
| PIC 1    | REV 16 | 750-009450 | CV2565      | 1x OC-192 SM SR2         |
| PIC 2    | REV 05 | 750-004424 | HH3057      | 1x 10GE(LAN), 10GBASE-LR |
| PIC 3    | REV 12 | 750-013423 | DP0403      | MultiServices 500        |
| MMB 0    | REV 04 | 710-016036 | DK1988      | ST-MMB2                  |
| FPC 5    | REV 07 | 710-013560 | DR0004      | E2-FPC Type 3            |
| CPU      | REV 05 | 710-013563 | DR0089      | FPC CPU-Enhanced         |
| PIC 0    | REV 11 | 750-012793 | DR6107      | 1x 10GE(LAN/WAN) IQ2     |
| Xcvr 0   | REV 01 | 740-014289 | C743XU074   | XFP-10G-SR               |
| PIC 1    | REV 01 | 750-004695 | HD5980      | 1x Tunnel                |
| PIC 2    | REV 32 | 750-003700 | DL3770      | 1x OC-192 12xMM VSR      |
| PIC 3    | REV 12 | 750-009553 | WB8901      | 4x OC-48 SONET           |
| Xcvr 0   | REV 01 | 740-011785 | P9D1GTQ     | SFP-SR                   |
| Xcvr 1   | REV 01 | 740-011785 | PDSOMMB     | SFP-SR                   |
| Xcvr 3   | REV 01 | 740-011785 | PDE1KXP     | SFP-SR                   |
| MMB 0    | REV 07 | 710-010171 | DP7374      | MMB-5M3-288mbit          |
| MMB 1    | REV 07 | 710-010171 | DP7404      | MMB-5M3-288mbit          |
| FPC 6    | REV 07 | 710-013035 | DM0994      | FPC Type 3-ES            |
| CPU      | REV 07 | 710-016744 | DM3651      | ST-PMB2                  |
| PIC 0    | REV 07 | 750-015217 | DN4743      | 8x 1GE(TYPE3), IQ2       |
| Xcvr 3   | REV 01 | 740-011613 | AM0812S8XB0 | SFP-SX                   |
| Xcvr 4   | REV 01 | 740-011782 | PB829RB     | SFP-SX                   |
| Xcvr 5   | REV 01 | 740-011782 | P8J1SYX     | SFP-SX                   |
| PIC 1    | REV 03 | 750-003336 | HJ9954      | 4x OC-48 SONET, SMSR     |
| PIC 3    | REV 02 | 750-012793 | JM7665      | 1x 10GE(LAN/WAN) IQ2     |
| MMB 0    | REV 04 | 710-016036 | DN6913      | ST-MMB2                  |
| FPC 7    | REV 08 | 710-010845 | JM3958      | FPC Type 4               |
| CPU      | REV 04 | 710-011481 | JK3669      | FPC CPU-Enhanced         |
| PIC 0    | REV 11 | 750-017405 | DP8837      | 4x 10GE (LAN/WAN) XFP    |

|            |        |            |              |                        |
|------------|--------|------------|--------------|------------------------|
| Xcvr 1     | REV 01 | 740-014279 | 753019A00277 | XFP-10G-LR             |
| Xcvr 2     | REV 02 | 740-011571 | C850XJ00P    | XFP-10G-SR             |
| Xcvr 3     | REV 01 | 740-014279 | AA0813N1RTG  | XFP-10G-LR             |
| MMB 0      | REV 04 | 710-010842 | JN1971       | ST-MMB                 |
| SPMB 0     | REV 04 | 710-023321 | DW3629       | LCC Switch CPU         |
| SPMB 1     | REV 04 | 710-023321 | DW3621       | LCC Switch CPU         |
| SIB 0      | REV 07 | 710-022594 | DW4200       | LCC SIB                |
| B Board    | REV 07 | 710-023185 | DW3932       | LCC SIB Mezz           |
| SIB 1      | REV 07 | 710-022594 | DW4193       | LCC SIB                |
| B Board    | REV 07 | 710-023185 | DW3904       | LCC SIB Mezz           |
| SIB 2      |        |            |              |                        |
| SIB 3      | REV 07 | 710-022594 | DW4210       | LCC SIB                |
| B Board    | REV 06 | 710-023185 | DT5780       | LCC SIB Mezz           |
| SIB 4      | REV 08 | 710-022594 | DW8019       | LCC SIB                |
| B Board    | REV 06 | 710-023185 | DT5795       | LCC SIB Mezz           |
| Fan Tray 0 |        |            |              | Front Top Fan Tray     |
| Fan Tray 1 |        |            |              | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |              | Rear Fan Tray -- Rev 3 |

### show chassis hardware sfc (TX Matrix Plus Router)

```
user@host> show chassis hardware sfc 0
sfc0-re0:
```

#### Hardware inventory:

| Item             | Version | Part number | Serial number | Description        |
|------------------|---------|-------------|---------------|--------------------|
| Chassis          |         |             | JN112F007AHB  | TXP                |
| Midplane         | REV 05  | 710-022574  | TS4027        | SFC Midplane       |
| FPM Display      | REV 03  | 710-024027  | DX0282        | TXP FPM Display    |
| CIP 0            | REV 04  | 710-023792  | DW4889        | TXP CIP            |
| CIP 1            | REV 04  | 710-023792  | DW4887        | TXP CIP            |
| PEM 0            | Rev 07  | 740-027463  | UM26368       | Power Entry Module |
| Routing Engine 0 | REV 01  | 740-026942  | 737A-1064     | SFC RE             |
| Routing Engine 1 | REV 01  | 740-026942  | 737A-1082     | SFC RE             |
| CB 0             | REV 09  | 710-022606  | DW6099        | SFC Control Board  |
| CB 1             | REV 09  | 710-022606  | DW6096        | SFC Control Board  |
| SPMB 0           |         | BUILTIN     |               | SFC Switch CPU     |
| SPMB 1           |         | BUILTIN     |               | SFC Switch CPU     |
| SIB F13 0        | REV 04  | 710-022600  | DX0841        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DX0966        | F13 SIB Mezz       |
| SIB F13 1        | REV 04  | 750-024564  | DW5776        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9028        | F13 SIB            |
| SIB F13 3        | REV 04  | 750-024564  | DW5762        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9059        | F13 SIB            |
| SIB F13 4        | REV 04  | 750-024564  | DW5797        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9041        | F13 SIB            |
| SIB F13 6        | REV 04  | 750-024564  | DW5770        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9079        | F13 SIB Mezz       |
| SIB F13 7        | REV 04  | 750-024564  | DW5758        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9047        | F13 SIB            |
| SIB F13 8        | REV 04  | 750-024564  | DW5761        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9043        | F13 SIB Mezz       |
| SIB F13 9        | REV 04  | 750-024564  | DW5754        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9078        | F13 SIB Mezz       |
| SIB F13 11       | REV 04  | 710-022600  | DX0826        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DX0967        | F13 SIB Mezz       |
| SIB F13 12       | REV 04  | 750-024564  | DW5794        | F13 SIB            |
| B Board          | REV 03  | 710-023431  | DW9044        | F13 SIB Mezz       |
| SIB F2S 0/0      | REV 05  | 710-022603  | DW7897        | F2S SIB            |
| B Board          | REV 05  | 710-023787  | DW7657        | NEO PMB            |
| SIB F2S 0/2      | REV 05  | 710-022603  | DW7833        | F2S SIB            |

|             |        |            |        |                |
|-------------|--------|------------|--------|----------------|
| B Board     | REV 05 | 710-023787 | DW7526 | NEO PMB        |
| SIB F2S 0/4 | REV 05 | 710-022603 | DW7875 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7588 | NEO PMB        |
| SIB F2S 0/6 | REV 05 | 710-022603 | DW7860 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7589 | NEO PMB        |
| SIB F2S 1/0 | REV 04 | 710-022603 | DW4820 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW8510 | NEO PMB        |
| SIB F2S 1/2 | REV 05 | 710-022603 | DW7849 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7525 | NEO PMB        |
| SIB F2S 1/4 | REV 05 | 710-022603 | DW7927 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7556 | F2S SIB Mezz   |
| SIB F2S 1/6 | REV 05 | 710-022603 | DW7866 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7651 | NEO PMB        |
| SIB F2S 2/0 | REV 05 | 710-022603 | DW7880 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7523 | NEO PMB        |
| SIB F2S 2/2 | REV 05 | 710-022603 | DW7895 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7591 | NEO PMB        |
| SIB F2S 2/4 | REV 05 | 710-022603 | DW7907 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7590 | NEO PMB        |
| SIB F2S 2/6 | REV 05 | 710-022603 | DW7785 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7524 | NEO PMB        |
| SIB F2S 3/0 | REV 05 | 710-022603 | DW7782 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7634 | NEO PMB        |
| SIB F2S 3/2 | REV 05 | 710-022603 | DW7793 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7548 | NEO PMB        |
| SIB F2S 3/4 | REV 05 | 710-022603 | DW7779 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7587 | NEO PMB        |
| SIB F2S 3/6 | REV 05 | 710-022603 | DW7930 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7505 | NEO PMB        |
| SIB F2S 4/0 | REV 05 | 710-022603 | DW7867 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7656 | NEO PMB        |
| SIB F2S 4/2 | REV 05 | 710-022603 | DW7917 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7640 | NEO PMB        |
| SIB F2S 4/4 | REV 05 | 710-022603 | DW7929 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7643 | NEO PMB        |
| SIB F2S 4/6 | REV 05 | 710-022603 | DW7870 | F2S SIB        |
| B Board     | REV 05 | 710-023787 | DW7635 | NEO PMB        |
| Fan Tray 0  | REV 06 | 760-024497 | DV7831 | Front Fan Tray |
| Fan Tray 1  | REV 06 | 760-024497 | DV9614 | Front Fan Tray |
| Fan Tray 2  | REV 06 | 760-024502 | DV9618 | Rear Fan Tray  |
| Fan Tray 3  | REV 06 | 760-024502 | DV9616 | Rear Fan Tray  |
| Fan Tray 4  | REV 06 | 760-024502 | DV7807 | Rear Fan Tray  |
| Fan Tray 5  | REV 06 | 760-024502 | DV7828 | Rear Fan Tray  |

### show chassis hardware extensive (TX Matrix Plus Router)

```
user@host> show chassis hardware extensive
sfc0-re0:
```

#### Hardware inventory:

```
Item          Version  Part number  Serial number  Description
Chassis
Jedec Code:   0x7fb0          EEPROM Version: 0x02
S/N:          JN112F007AHB
Assembly ID:  0x052c          Assembly Version: 00.00
Date:         00-00-0000      Assembly Flags:  0x00
ID: TXP
Board Information Record:
Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
I2C Hex Data:
Address 0x00: 7f b0 02 ff 05 2c 00 00 00 00 00 00 00 00 00 00
```

```

Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: 4a 4e 31 31 32 46 30 30 37 41 48 42 00 00 00 00
Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane          REV 05    710-022574    TS4027          SFC Midplane
Jedec Code:      0x7fb0          EEPROM Version: 0x01
P/N:             710-022574      S/N:           TS4027
Assembly ID:     0x0962          Assembly Version: 01.05
Date:           03-23-2009      Assembly Flags: 0x00
Version:         REV 05
ID: SFC Midplane
Board Information Record:
Address 0x00: ad 01 ff ff 00 1d b5 14 00 00 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 09 62 01 05 52 45 56 20 30 35 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 32 32 35 37 34 00 00
Address 0x20: 53 2f 4e 20 54 53 34 30 32 37 00 00 00 17 03 07
Address 0x30: d9 ff ff ff ad 01 ff ff 00 1d b5 14 00 00 ff ff
Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Display       REV 03    710-024027    DX0282          TXP FPM Display
Jedec Code:      0x7fb0          EEPROM Version: 0x01
P/N:             710-024027      S/N:           DX0282
Assembly ID:     0x096c          Assembly Version: 01.03
Date:           02-10-2009      Assembly Flags: 0x00
Version:         REV 03
ID: TXP FPM Display          FRU Model Number: CRAFT-TXP
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 09 6c 01 03 52 45 56 20 30 33 00 00
Address 0x10: 00 00 00 00 37 31 30 2d 30 32 34 30 32 37 00 00
Address 0x20: 53 2f 4e 20 44 58 30 32 38 32 00 00 00 0a 02 07
Address 0x30: d9 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 43
Address 0x50: 52 41 46 54 2d 54 58 50 00 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
CIP 0             REV 04    710-023792    DW4889          TXP CIP
Jedec Code:      0x7fb0          EEPROM Version: 0x01
P/N:             710-023792      S/N:           DW4889
Assembly ID:     0x0969          Assembly Version: 01.04
Date:           01-26-2009      Assembly Flags: 0x00
Version:         REV 04
ID: TXP CIP          FRU Model Number: CIP-TXP
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

```

#### show chassis hardware clei-models (TX Matrix Plus Router)

```

user@host> show chassis hardware clei-models
sfc0-re0:

```

```

-----
Hardware inventory:
Item          Version  Part number  CLEI code          FRU model number
Midplane      REV 05   710-022574   CHAS-BP-TXP-S

```



|                  |        |            |            |                    |
|------------------|--------|------------|------------|--------------------|
| FPM Display      | REV 03 | 710-024027 |            | CRAFT-TXP-S        |
| CIP 0            | REV 05 | 710-023792 |            | CIP-TXP-S          |
| CIP 1            | REV 05 | 710-023792 |            | CIP-TXP-S          |
| PEM 0            | Rev 04 | 740-027463 | IPUPAFGKTA | PWR-TXP-7-60-DC    |
| PEM 1            | Rev 04 | 740-027463 | IPUPAFGKTA | PWR-TXP-7-60-DC    |
| Routing Engine 0 | REV 06 | 740-026942 |            | RE-DUO-C2600-16G-S |
| Routing Engine 1 | REV 06 | 740-026942 |            | RE-DUO-C2600-16G-S |
| CB 0             | REV 05 | 710-022606 |            | CB-TXP-S           |
| CB 1             | REV 09 | 710-022606 |            | CB-TXP-S           |
| SIB F13 0        | REV 04 | 750-024564 |            | SIB-TXP-F13        |
| SIB F13 3        | REV 04 | 750-024564 |            | SIB-TXP-F13        |
| SIB F13 8        | REV 04 | 750-024564 |            | SIB-TXP-F13        |
| SIB F13 11       | REV 04 | 750-024564 |            | SIB-TXP-F13        |
| SIB F13 12       | REV 03 | 750-024564 |            | SIB-TXP-F13        |
| SIB F2S 0/0      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 0/2      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 0/4      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 0/6      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 1/0      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 1/2      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 1/4      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 1/6      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 2/0      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 2/2      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 2/4      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 2/6      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 3/0      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 3/2      | REV 03 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 3/4      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 3/6      | REV 03 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 4/0      | REV 03 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 4/2      | REV 05 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 4/4      | REV 04 | 710-022603 |            | SIB-TXP-F2S-S      |
| SIB F2S 4/6      | REV 03 | 710-022603 |            | SIB-TXP-F2S-S      |
| Fan Tray 0       | REV 02 | 760-024497 |            | FANTRAY-TXP-H-S    |
| Fan Tray 1       | REV 02 | 760-024497 |            | FANTRAY-TXP-H-S    |
| Fan Tray 2       | REV 05 | 760-024502 |            | FANTRAY-TXP-V-S    |
| Fan Tray 3       |        |            |            |                    |
| Fan Tray 4       | REV 05 | 760-024502 |            | FANTRAY-TXP-V-S    |
| Fan Tray 5       | REV 02 | 760-024502 |            | FANTRAY-TXP-V-S    |

lcc0-re0:

-----  
Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number     |
|------------------|---------|-------------|------------|----------------------|
| Midplane         | REV 03  | 710-017247  |            | CHAS-BP-T1600-S      |
| FPM Display      | REV 01  | 710-021387  |            | CRAFT-T1600-S        |
| CIP              | REV 06  | 710-002895  |            | CIP-L-T640-S         |
| PEM 1            | Rev 02  | 740-023211  | IPUPAC8KTA | PWR-T1600-4-60-DC-S  |
| SCG 0            | REV 15  | 710-003423  |            | SCG-T-S              |
| SCG 1            | REV 15  | 710-003423  |            | SCG-T-S              |
| Routing Engine 0 | REV 01  | 740-026941  |            | RE-DUO-C1800-8G-S    |
| Routing Engine 1 | REV 01  | 740-026941  |            | RE-DUO-C1800-8G-S    |
| CB 0             | REV 06  | 710-022597  |            | CB-LCC-S             |
| CB 1             | REV 06  | 710-022597  |            | CB-LCC-S             |
| FPC 1            | REV 07  | 710-013035  |            | T640-FPC3-ES         |
| PIC 0            | REV 05  | 750-015217  |            | PC-8GE-TYPE3-SFP-IQ2 |
| PIC 1            | REV 03  | 750-004424  |            | PC-1XGE-LR           |
| PIC 2            | REV 01  | 750-003336  |            | PC-40C48-SON-SMSR    |
| FPC 3            | REV 12  | 710-013037  |            | T1600-FPC4-ES        |
| PIC 0            | REV 02  | 750-010850  |            | PD-10C768-SON-SR     |

|            |        |            |                         |
|------------|--------|------------|-------------------------|
| FPC 4      | REV 05 | 710-021534 | T640-FPC1-ES            |
| PIC 0      | REV 04 | 750-014627 | PB-40C3-10C12-SON-SFP   |
| PIC 1      | REV 22 | 750-005634 | PB-1CHOC12SMIR-QPP      |
| PIC 2      | REV 09 | 750-002911 | PB-4FE-TX               |
| PIC 3      | REV 08 | 750-021652 | PB-1CHOC12-STM4-IQE-SFP |
| FPC 5      | REV 07 | 710-007529 | T640-FPC3               |
| PIC 0      | REV 14 | 750-009567 | PC-1XGE-XENPAK          |
| PIC 1      | REV 16 | 750-007141 | PC-10GE-SFP             |
| PIC 2      | REV 12 | 750-009567 | PC-1XGE-XENPAK          |
| FPC 6      | REV 07 | 710-013035 | T640-FPC3-ES            |
| PIC 0      | REV 09 | 750-009567 | PC-1XGE-XENPAK          |
| PIC 1      | REV 06 | 750-015217 | PC-8GE-TYPE3-SFP-IQ2    |
| PIC 2      | REV 06 | 750-015217 | PC-8GE-TYPE3-SFP-IQ2    |
| FPC 7      | REV 03 | 710-021540 | T640-FPC2-ES            |
| PIC 0      | REV 13 | 750-001901 | PB-40C12-SON-SMIR       |
| PIC 1      | REV 05 | 750-001900 | PB-10C48-SON-SMSR       |
| PIC 2      | REV 10 | 750-008155 | PB-2GE-SFP-QPP          |
| PIC 3      | REV 03 | 750-014638 | PB-10C48-SON-B-SFP      |
| SIB 0      | REV 07 | 710-022594 | SIB-TXP-T1600-S         |
| SIB 1      | REV 07 | 710-022594 | SIB-TXP-T1600-S         |
| SIB 3      | REV 06 | 710-022594 | SIB-TXP-T1600-S         |
| SIB 4      | REV 08 | 710-022594 | SIB-TXP-T1600-S         |
| Fan Tray 0 |        |            | FANTRAY-T-S             |
| Fan Tray 1 |        |            | FANTRAY-T-S             |
| Fan Tray 2 |        |            | FANTRAY-TXP-R-S         |

lcc1-re0:

-----  
Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number      |
|------------------|---------|-------------|------------|-----------------------|
| Midplane         | REV 04  | 710-017247  |            | CHAS-BP-T1600-S       |
| FPM Display      | REV 01  | 710-021387  |            | CRAFT-T1600-S         |
| CIP              | REV 06  | 710-002895  |            | CIP-L-T640-S          |
| PEM 0            | Rev 02  | 740-023211  | IPUPAC8KTA | PWR-T1600-4-60-DC-S   |
| SCG 0            | REV 15  | 710-003423  |            | SCG-T-S               |
| SCG 1            | REV 15  | 710-003423  |            | SCG-T-S               |
| Routing Engine 0 | REV 01  | 740-026941  |            | RE-DUO-C1800-8G-S     |
| Routing Engine 1 | REV 01  | 740-026941  |            | RE-DUO-C1800-8G-S     |
| CB 0             | REV 06  | 710-022597  |            | CB-LCC-S              |
| CB 1             | REV 06  | 710-022597  |            | CB-LCC-S              |
| FPC 0            | REV 02  | 710-010845  |            | T640-FPC4-ES          |
| PIC 0            | REV 11  | 750-017405  |            | PD-4XGE-XFP           |
| FPC 1            | REV 16  | 710-013037  |            | T1600-FPC4-ES         |
| PIC 1            | REV 06  | 750-034781  |            | PD-1CE-CFP            |
| FPC 2            | REV 16  | 710-013037  |            | T1600-FPC4-ES         |
| PIC 1            | REV 05  | 750-034781  |            | PD-1CE-CFP            |
| FPC 3            | REV 10  | 710-021534  |            | T640-FPC1-ES          |
| PIC 0            | REV 13  | 750-012266  |            | PB-4GE-TYPE1-SFP-IQ2  |
| PIC 1            | REV 01  | 750-007641  |            | PE-1GE-SFP-QPP        |
| PIC 3            | REV 17  | 750-007444  |            | PB-1CHSTM1-SMIR-QPP   |
| FPC 4            | REV 06  | 710-013035  |            | T640-FPC3-ES          |
| PIC 0            | REV 22  | 750-007141  |            | PC-10GE-SFP           |
| PIC 1            | REV 16  | 750-009450  |            | PC-10C192-SON-SR2     |
| PIC 2            | REV 05  | 750-004424  |            | PC-1XGE-LR            |
| PIC 3            | REV 12  | 750-013423  |            | PC-MS-500-3           |
| FPC 5            | REV 07  | 710-013560  |            | T640-FPC3-E2          |
| PIC 0            | REV 11  | 750-012793  |            | PC-1XGE-TYPE3-XFP-IQ2 |
| PIC 1            | REV 01  | 750-004695  |            | PC-TUNNEL             |
| PIC 2            | REV 32  | 750-003700  |            | PC-10C192-SON-VSR     |
| PIC 3            | REV 12  | 750-009553  |            | PC-40C48-SON-SFP      |
| FPC 6            | REV 07  | 710-013035  |            | T640-FPC3-ES          |

|            |        |            |                       |
|------------|--------|------------|-----------------------|
| PIC 0      | REV 07 | 750-015217 | PC-8GE-TYPE3-SFP-IQ2  |
| PIC 1      | REV 03 | 750-003336 | PC-40C48-SON-SMSR     |
| PIC 3      | REV 02 | 750-012793 | PC-1XGE-TYPE3-XFP-IQ2 |
| FPC 7      | REV 08 | 710-010845 | T640-FPC4-ES          |
| PIC 0      | REV 11 | 750-017405 | PD-4XGE-XFP           |
| SIB 0      | REV 07 | 710-022594 | SIB-TXP-T1600-S       |
| SIB 1      | REV 07 | 710-022594 | SIB-TXP-T1600-S       |
| SIB 3      | REV 07 | 710-022594 | SIB-TXP-T1600-S       |
| SIB 4      | REV 08 | 710-022594 | SIB-TXP-T1600-S       |
| Fan Tray 0 |        |            | FANTRAY-T-S           |
| Fan Tray 1 |        |            | FANTRAY-T-S           |
| Fan Tray 2 |        |            | FANTRAY-TXP-R-S       |

### show chassis hardware detail (TX Matrix Plus Router)

```
user@host> show chassis hardware detail
sfc0-re0:
```

#### ----- Hardware inventory:

| Item             | Version  | Part number             | Serial number        | Description        |
|------------------|----------|-------------------------|----------------------|--------------------|
| Chassis          |          |                         | JN111B023AHB         | TXP                |
| Midplane         | REV 01   | 710-022574              | TR7990               | SFC Midplane       |
| FPM Display      | REV 03   | 710-024027              | DW4699               | TXP FPM Display    |
| CIP 0            | REV 01   | 710-023792              | DR1437               | TXP CIP            |
| CIP 1            | REV 02   | 710-023792              | DS4564               | TXP CIP            |
| PEM 0            | Rev 07   | 740-027463              | UM26360              | Power Entry Module |
| Routing Engine 0 | REV 01   | 740-026942              | 737A-1024            | SFC RE             |
| ad0              | 3887 MB  | SMART CF                | 200811050193CEB1CEB1 | Compact Flash      |
| ad1              | 30533 MB | SAMSUNG MCBQE32G8MPP-0V | SY814A0762           | Disk 1             |
| Routing Engine 1 | REV 01   | 740-026942              | 737A-1024            | SFC RE             |
| ad0              | 3887 MB  | SMART CF                | 20081105004C19A019A0 | Compact Flash      |
| ad1              | 30533 MB | SAMSUNG MCBQE32G8MPP-0V | SY814A0794           | Disk 1             |
| CB 0             | REV 03   | 710-022606              | DR7134               | SFC Control Board  |
| CB 1             | REV 01   | 710-022606              | DP8890               | SFC Control Board  |
| SPMB 0           |          | BUILTIN                 |                      | SFC Switch CPU     |
| SPMB 1           |          | BUILTIN                 |                      | SFC Switch CPU     |
| SIB F13 0        | REV 03   | 750-024564              | DT9478               | F13 SIB            |
| B Board          | REV 02   | 710-023431              | DT6554               | F13 SIB            |
| SIB F13 1        | REV 03   | 750-024564              | DT9454               | F13 SIB            |
| B Board          | REV 02   | 710-023431              | DT6551               | F13 SIB            |
| SIB F2S 0/0      | REV 02   | 710-022603              | DT2838               | F2S SIB            |
| B Board          | REV 02   | 710-023787              | DT1725               | NEO PMB            |
| SIB F2S 0/2      | REV 02   | 710-022603              | DT2824               | F2S SIB            |
| B Board          | REV 02   | 710-023787              | DT1706               | NEO PMB            |
| SIB F2S 0/4      | REV 02   | 710-022603              | DT2822               | F2S SIB            |
| B Board          | REV 02   | 710-023787              | DT1696               | NEO PMB            |
| SIB F2S 0/6      | REV 02   | 710-022603              | DT2823               | F2S SIB            |
| B Board          | REV 02   | 710-023787              | DT1717               | NEO PMB            |
| SIB F2S 1/0      | REV 03   | 710-022603              | DV0059               | F2S SIB            |
| B Board          | REV 03   | 710-023787              | DT9942               | NEO PMB            |
| SIB F2S 1/2      | REV 02   | 710-022603              | DT2826               | F2S SIB            |
| B Board          | REV 02   | 710-023787              | DT1713               | NEO PMB            |
| SIB F2S 1/4      | REV 03   | 710-022603              | DV0092               | F2S SIB            |
| B Board          | REV 03   | 710-023787              | DV0000               | NEO PMB            |
| SIB F2S 1/6      | REV 03   | 710-022603              | DV0079               | F2S SIB            |
| B Board          | REV 03   | 710-023787              | DT9972               | NEO PMB            |
| SIB F2S 2/0      | REV 03   | 710-022603              | DV0100               | F2S SIB            |
| B Board          | REV 03   | 710-023787              | DT9925               | NEO PMB            |
| SIB F2S 2/2      | REV 03   | 710-022603              | DV0050               | F2S SIB            |
| B Board          | REV 03   | 710-023787              | DV0005               | NEO PMB            |
| SIB F2S 2/4      | REV 03   | 710-022603              | DV0097               | F2S SIB            |

|            |        |            |        |                |
|------------|--------|------------|--------|----------------|
| B Board    | REV 03 | 710-023787 | DT9936 | NEO PMB        |
| Fan Tray 0 | REV 02 | 760-024497 | DR8286 | Front Fan Tray |
| Fan Tray 1 | REV 06 | 760-024497 | DV9624 | Front Fan Tray |
| Fan Tray 2 | REV 02 | 760-024502 | DR8259 | Rear Fan Tray  |
| Fan Tray 3 | REV 02 | 760-024502 | DR8270 | Rear Fan Tray  |
| Fan Tray 4 | REV 02 | 760-024502 | DR8284 | Rear Fan Tray  |
| Fan Tray 5 | REV 06 | 760-024502 | DV7813 | Rear Fan Tray  |

lcc0-re0:

-----  
Hardware inventory:

| Item             | Version  | Part number             | Serial number        | Description             |
|------------------|----------|-------------------------|----------------------|-------------------------|
| Chassis          |          |                         | JN1101F27AHA         | T1600                   |
| Midplane         | REV 04   | 710-017247              | RC5317               | T Series Backplane      |
| FPM GBUS         | REV 10   | 710-002901              | DS8197               | T640 FPM Board          |
| FPM Display      | REV 01   | 710-021387              | DS6433               | T1600 FPM Display       |
| CIP              | REV 06   | 710-002895              | DS1493               | T Series CIP            |
| PEM 0            | Rev 08   | 740-017906              | UD26601              | Power Entry Module 3x80 |
| SCG 0            | REV 15   | 710-003423              | DP5847               | T640 Sonet Clock Gen.   |
| SCG 1            | REV 15   | 710-003423              | DR0924               | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 01   | 740-026942              | 737F-1024            | LCC RE                  |
| ad0              | 3887 MB  | SMART CF                | 2008110502B63E513E51 | Compact Flash           |
| ad1              | 30533 MB | SAMSUNG MCBQE32G8MPP-0V | SY814A1208           | Disk 1                  |
| Routing Engine 1 | REV 01   | 740-026942              | 737F-1024            | LCC RE                  |
| ad0              | 3887 MB  | SMART CF                | 2008110500F9A8A8A8A8 | Compact Flash           |
| ad1              | 30533 MB | SAMSUNG MCBQE32G8MPP-0V | SY814A1076           | Disk 1                  |
| CB 0             | REV 05   | 710-022597              | DV4264               | LCC Control Board       |
| CB 1             | REV 03   | 710-022597              | DP8558               | LCC Control Board       |
| FPC 0            | REV 14   | 710-013037              | DS9967               | FPC Type 4-ES           |
| CPU              | REV 08   | 710-016744              | DS3989               | ST-PMB2                 |
| PIC 0            | REV 12   | 750-013198              | DL7506               | 1x Tunnel               |
| PIC 1            | REV 12   | 750-013198              | DL7505               | 1x Tunnel               |
| MMB 0            | REV 01   | 710-025563              | DS8524               | ST-MMB2                 |
| MMB 1            | REV 01   | 710-025563              | DS8373               | ST-MMB2                 |
| FPC 1            | REV 14   | 710-013037              | DT0027               | FPC Type 4-ES           |
| CPU              | REV 09   | 710-016744              | DS7684               | ST-PMB2                 |
| PIC 0            | REV 12   | 750-013198              | DL7512               | 1x Tunnel               |
| PIC 1            | REV 12   | 750-013198              | DL7498               | 1x Tunnel               |
| MMB 0            | REV 01   | 710-025563              | DS8494               | ST-MMB2                 |
| MMB 1            | REV 01   | 710-025563              | DS8436               | ST-MMB2                 |
| SPMB 0           | REV 04   | 710-023321              | DV3867               | LCC Switch CPU          |
| SPMB 1           | REV 02   | 710-023321              | DP0238               | LCC Switch CPU          |
| SIB 0            | REV 06   | 710-022594              | DT8268               | LCC SIB                 |
| B Board          | REV 06   | 710-023185              | DT5791               | LCC SIB Mezz            |
| SIB 1            | REV 06   | 710-022594              | DT8261               | LCC SIB                 |
| B Board          | REV 06   | 710-023185              | DT5769               | LCC SIB Mezz            |
| SIB 2            | REV 04   | 710-022594              | DS2315               | LCC SIB                 |
| B Board          | REV 06   | 710-023185              | DT5788               | LCC SIB Mezz            |
| SIB 3            | REV 06   | 710-022594              | DT8253               | LCC SIB                 |
| B Board          | REV 06   | 710-023185              | DT5811               | LCC SIB Mezz            |
| SIB 4            | REV 06   | 710-022594              | DT8248               | LCC SIB                 |
| B Board          | REV 06   | 710-023185              | DT5812               | LCC SIB Mezz            |
| Fan Tray 0       |          |                         |                      | Front Top Fan Tray      |
| Fan Tray 1       |          |                         |                      | Front Bottom Fan Tray   |
| Fan Tray 2       |          |                         |                      | Rear Fan Tray           |

show chassis hardware models (TX Matrix Plus Router)

```
user@host> show chassis hardware models
sfc0-re0:
```

## Hardware inventory:

| Item             | Version | Part number | Serial number | FRU model number        |
|------------------|---------|-------------|---------------|-------------------------|
| FPM Display      | REV 03  | 710-024027  | DX0282        | CRAFT-TXP               |
| CIP 0            | REV 04  | 710-023792  | DW4889        | CIP-TXP                 |
| CIP 1            | REV 04  | 710-023792  | DW4887        | CIP-TXP                 |
| PEM 0            | Rev 07  | 740-027463  | UM26368       | yyyyyyyyyyyyyyyyyyyy    |
| Routing Engine 0 | REV 01  | 740-026942  | 737A-1064     | RE-TXP-SFC-DUO-2600-16G |
| Routing Engine 1 | REV 01  | 740-026942  | 737A-1082     | RE-TXP-SFC-DUO-2600-16G |
| CB 0             | REV 09  | 710-022606  | DW6099        | CB-TXP                  |
| CB 1             | REV 09  | 710-022606  | DW6096        | CB-TXP                  |
| SIB F13 1        | REV 04  | 750-024564  | DW5776        | SIB-TXP-F13             |
| SIB F13 3        | REV 04  | 750-024564  | DW5762        | SIB-TXP-F13             |
| SIB F13 4        | REV 04  | 750-024564  | DW5797        | SIB-TXP-F13             |
| SIB F13 6        | REV 04  | 750-024564  | DW5770        | SIB-TXP-F13             |
| SIB F13 7        | REV 04  | 750-024564  | DW5758        | SIB-TXP-F13             |
| SIB F13 8        | REV 04  | 750-024564  | DW5761        | SIB-TXP-F13             |
| SIB F13 9        | REV 04  | 750-024564  | DW5754        | SIB-TXP-F13             |
| SIB F13 12       | REV 04  | 750-024564  | DW5794        | SIB-TXP-F13             |
| SIB F2S 0/0      | REV 05  | 710-022603  | DW7897        |                         |
| SIB F2S 0/2      | REV 05  | 710-022603  | DW7833        |                         |
| SIB F2S 0/4      | REV 05  | 710-022603  | DW7875        |                         |
| SIB F2S 0/6      | REV 05  | 710-022603  | DW7860        |                         |
| SIB F2S 1/0      | REV 04  | 710-022603  | DW4820        |                         |
| SIB F2S 1/2      | REV 05  | 710-022603  | DW7849        |                         |
| SIB F2S 1/4      | REV 05  | 710-022603  | DW7927        | SIB-TXP-F2S             |
| SIB F2S 1/6      | REV 05  | 710-022603  | DW7866        |                         |
| SIB F2S 2/0      | REV 05  | 710-022603  | DW7880        |                         |
| SIB F2S 2/2      | REV 05  | 710-022603  | DW7895        |                         |
| SIB F2S 2/4      | REV 05  | 710-022603  | DW7907        |                         |
| SIB F2S 2/6      | REV 05  | 710-022603  | DW7785        |                         |
| SIB F2S 3/0      | REV 05  | 710-022603  | DW7782        |                         |
| SIB F2S 3/2      | REV 05  | 710-022603  | DW7793        |                         |
| SIB F2S 3/4      | REV 05  | 710-022603  | DW7779        |                         |
| SIB F2S 3/6      | REV 05  | 710-022603  | DW7930        |                         |
| SIB F2S 4/0      | REV 05  | 710-022603  | DW7867        |                         |
| SIB F2S 4/2      | REV 05  | 710-022603  | DW7917        |                         |
| SIB F2S 4/4      | REV 05  | 710-022603  | DW7929        |                         |
| SIB F2S 4/6      | REV 05  | 710-022603  | DW7870        |                         |
| Fan Tray 0       | REV 06  | 760-024497  | DV7831        | FANTRAY-TXP-F           |
| Fan Tray 1       | REV 06  | 760-024497  | DV9614        | FANTRAY-TXP-F           |
| Fan Tray 2       | REV 06  | 760-024502  | DV9618        | FANTRAY-TXP-R           |
| Fan Tray 3       | REV 06  | 760-024502  | DV9616        | FANTRAY-TXP-R           |
| Fan Tray 4       | REV 06  | 760-024502  | DV7807        | FANTRAY-TXP-R           |
| Fan Tray 5       | REV 06  | 760-024502  | DV7828        | FANTRAY-TXP-R           |

lcc0-re0:

## Hardware inventory:

| Item        | Version | Part number | Serial number | FRU model number    |
|-------------|---------|-------------|---------------|---------------------|
| Midplane    | REV 03  | 710-017247  | RC3765        | CHAS-BP-T1600-S     |
| FPM Display | REV 01  | 710-021387  | DN5441        | CRAFT-T1600-S       |
| CIP         | REV 06  | 710-002895  | DP6021        | CIP-L-T640-S        |
| PEM 0       | Rev 07  | 740-017906  | UA26384       | PWR-T1600-3-80-DC-S |
| PEM 1       | Rev 07  | 740-017906  | UA26296       | PWR-T1600-3-80-DC-S |
| SCG 0       | REV 15  | 710-003423  | DR0875        | SCG-T-S             |
| CB 0        | REV 06  | 710-022597  | DW8534        | CB-LCC              |
| CB 1        | REV 06  | 710-022597  | DW8527        | CB-LCC              |
| FPC 4       | REV 12  | 710-013037  | DJ8717        | T1600-FPC4-ES       |
| PIC 0       | REV 11  | 750-017405  | DP8795        | PD-4XGE-XFP         |
| PIC 1       | REV 11  | 750-017405  | DP8794        | PD-4XGE-XFP         |
| FPC 6       | REV 14  | 710-013037  | DS5335        | T1600-FPC4-ES       |

|            |        |            |        |                   |
|------------|--------|------------|--------|-------------------|
| PIC 0      | REV 13 | 750-017405 | DS7634 | PD-4XGE-XFP       |
| PIC 1      | REV 13 | 750-017405 | DS7637 | PD-4XGE-XFP       |
| FPC 7      | REV 07 | 710-013035 | DM0990 | T1600-FPC3-ES     |
| PIC 0      | REV 16 | 750-007141 | JJ8067 | PC-10GE-SFP       |
| PIC 1      | REV 08 | 750-015749 | WE9598 | PC-10C192-SON-XFP |
| PIC 2      | REV 10 | 750-009450 | HX6466 | PC-10C192-SON-SR2 |
| SIB 0      | REV 08 | 710-022594 | DW8033 | SIB-TXP-T1600-S   |
| SIB 1      | REV 08 | 710-022594 | DW8044 | SIB-TXP-T1600-S   |
| SIB 2      | REV 08 | 710-022594 | DW8020 | SIB-TXP-T1600-S   |
| SIB 3      | REV 08 | 710-022594 | DW8063 | SIB-TXP-T1600-S   |
| SIB 4      | REV 08 | 710-022594 | DW8064 | SIB-TXP-T1600-S   |
| Fan Tray 0 |        |            |        | FANTRAY-T-S       |
| Fan Tray 1 |        |            |        | FANTRAY-T-S       |
| Fan Tray 2 |        |            |        | FANTRAY-TXP-R-S   |

lcc1-re0:

-----  
Hardware inventory:

| Item        | Version | Part number | Serial number | FRU model number    |
|-------------|---------|-------------|---------------|---------------------|
| Midplane    | REV 04  | 710-017247  | RC5361        | CHAS-BP-T1600-S     |
| FPM Display | REV 01  | 710-021387  | DS6430        | CRAFT-T1600-S       |
| CIP         | REV 06  | 710-002895  | DS4239        | CIP-L-T640-S        |
| PEM 0       | Rev 08  | 740-017906  | UD26649       | PWR-T1600-3-80-DC-S |
| SCG 0       | REV 15  | 710-003423  | DP5820        | SCG-T-S             |
| CB 0        | REV 06  | 710-022597  | DW8523        | CB-LCC              |
| CB 1        | REV 06  | 710-022597  | DW8528        | CB-LCC              |
| FPC 4       | REV 12  | 710-013037  | DP8509        | T1600-FPC4-ES       |
| PIC 0       | REV 11  | 750-017405  | DP8808        | PD-4XGE-XFP         |
| PIC 1       | REV 11  | 750-017405  | DP7263        | PD-4XGE-XFP         |
| FPC 6       | REV 14  | 710-013037  | DS9961        | T1600-FPC4-ES       |
| PIC 0       | REV 13  | 750-017405  | DS5532        | PD-4XGE-XFP         |
| PIC 1       | REV 13  | 750-017405  | DS7639        | PD-4XGE-XFP         |
| FPC 7       | REV 03  | 710-013035  | DF5564        | T1600-FPC3-ES       |
| PIC 0       | REV 16  | 750-007141  | JJ8063        | PC-10GE-SFP         |
| SIB 0       | REV 08  | 710-022594  | DW8035        | SIB-TXP-T1600-S     |
| SIB 1       | REV 10  | 710-022594  | DX7672        | SIB-TXP-T1600-S     |
| SIB 2       | REV 08  | 710-022594  | DW8060        | SIB-TXP-T1600-S     |
| SIB 3       | REV 08  | 710-022594  | DW8072        | SIB-TXP-T1600-S     |
| SIB 4       | REV 08  | 710-022594  | DW8043        | SIB-TXP-T1600-S     |
| Fan Tray 0  |         |             |               | FANTRAY-T-S         |
| Fan Tray 1  |         |             |               | FANTRAY-T-S         |
| Fan Tray 2  |         |             |               | FANTRAY-TXP-R-S     |

lcc2-re0:

-----  
Hardware inventory:

| Item        | Version | Part number | Serial number | FRU model number    |
|-------------|---------|-------------|---------------|---------------------|
| Midplane    | REV 03  | 710-017247  | RC3956        | CHAS-BP-T1600-S     |
| FPM Display | REV 01  | 710-021387  | DN7030        | CRAFT-T1600-S       |
| CIP         | REV 06  | 710-002895  | DM3962        | CIP-L-T640-S        |
| PEM 0       | Rev 08  | 740-017906  | UD26519       | PWR-T1600-3-80-DC-S |
| PEM 1       | Rev 07  | 740-017906  | UC26601       | PWR-T1600-3-80-DC-S |
| SCG 0       | REV 15  | 710-003423  | DP0277        | SCG-T-S             |
| CB 0        | REV 06  | 710-022597  | DW8524        | CB-LCC              |
| CB 1        | REV 06  | 710-022597  | DW8536        | CB-LCC              |
| FPC 4       | REV 12  | 710-013037  | DR1194        | T1600-FPC4-ES       |
| PIC 0       | REV 11  | 750-017405  | DP8811        | PD-4XGE-XFP         |
| PIC 1       | REV 11  | 750-017405  | DP8823        | PD-4XGE-XFP         |
| FPC 5       | REV 12  | 710-013037  | DR1184        | T1600-FPC4-ES       |
| PIC 1       | REV 11  | 750-017405  | DP4744        | PD-4XGE-XFP         |
| FPC 6       | REV 12  | 710-013037  | DN8622        | T1600-FPC4-ES       |

|            |        |            |        |                   |
|------------|--------|------------|--------|-------------------|
| PIC 0      | REV 14 | 750-012518 | JY9924 | PD-40C192-SON-XFP |
| PIC 1      | REV 11 | 750-017405 | DP8776 | PD-4XGE-XFP       |
| FPC 7      | REV 04 | 710-013560 | JR3968 | T640-FPC3-E2      |
| PIC 0      | REV 16 | 750-007141 | NC9330 | PC-10GE-SFP       |
| SIB 0      | REV 07 | 710-022594 | DW4217 | SIB-TXP-T1600-S   |
| SIB 1      | REV 07 | 710-022594 | DW4213 | SIB-TXP-T1600-S   |
| SIB 2      | REV 07 | 710-022594 | DW4189 | SIB-TXP-T1600-S   |
| SIB 3      | REV 07 | 710-022594 | DW4173 | SIB-TXP-T1600-S   |
| SIB 4      | REV 07 | 710-022594 | DW4201 | SIB-TXP-T1600-S   |
| Fan Tray 0 |        |            |        | FANTRAY-T-S       |
| Fan Tray 1 |        |            |        | FANTRAY-T-S       |
| Fan Tray 2 |        |            |        | FANTRAY-TXP-R-S   |

lcc3-re0:

-----  
Hardware inventory:

| Item        | Version | Part number | Serial number | FRU model number    |
|-------------|---------|-------------|---------------|---------------------|
| Midplane    | REV 04  | 710-017247  | RC5319        | CHAS-BP-T1600-S     |
| FPM Display | REV 01  | 710-021387  | DS6402        | CRAFT-T1600-S       |
| CIP         | REV 06  | 710-002895  | DR9973        | CIP-L-T640-S        |
| PEM 0       | Rev 07  | 740-017906  | UC26496       | PWR-T1600-3-80-DC-S |
| PEM 1       | Rev 07  | 740-017906  | UC26599       | PWR-T1600-3-80-DC-S |
| SCG 0       | REV 15  | 710-003423  | DP5831        | SCG-T-S             |
| CB 0        | REV 06  | 710-022597  | DW8533        | CB-LCC              |
| CB 1        | REV 06  | 710-022597  | DW8538        | CB-LCC              |
| FPC 0       | REV 14  | 710-013037  | DS5345        | T1600-FPC4-ES       |
| PIC 0       | REV 13  | 750-017405  | DS7641        | PD-4XGE-XFP         |
| PIC 1       | REV 13  | 750-017405  | DS5479        | PD-4XGE-XFP         |
| FPC 1       | REV 14  | 710-013037  | DS7338        | T1600-FPC4-ES       |
| PIC 0       | REV 13  | 750-017405  | DS7631        | PD-4XGE-XFP         |
| PIC 1       | REV 13  | 750-017405  | DS7632        | PD-4XGE-XFP         |
| FPC 2       | REV 14  | 710-013037  | DS9962        | T1600-FPC4-ES       |
| PIC 0       | REV 13  | 750-017405  | DS7581        | PD-4XGE-XFP         |
| PIC 1       | REV 13  | 750-017405  | DS7627        | PD-4XGE-XFP         |
| FPC 4       | REV 10  | 710-010845  | JZ6573        | T640-FPC4-ES        |
| PIC 0       | REV 14  | 750-012518  | JT5124        | PD-40C192-SON-XFP   |
| FPC 5       | REV 14  | 710-013037  | DT0016        | T1600-FPC4-ES       |
| PIC 0       | REV 14  | 750-012518  | JY9918        | PD-40C192-SON-XFP   |
| FPC 7       | REV 07  | 710-013035  | DM0967        | T1600-FPC3-ES       |
| PIC 0       | REV 16  | 750-007141  | JJ8059        | PC-10GE-SFP         |
| PIC 1       | REV 13  | 750-004695  | DM5712        | PC-TUNNEL           |
| SIB 0       | REV 07  | 710-022594  | DW4174        | SIB-TXP-T1600-S     |
| SIB 1       | REV 07  | 710-022594  | DW4207        | SIB-TXP-T1600-S     |
| SIB 2       | REV 06  | 710-022594  | DT8231        | SIB-TXP-T1600-S     |
| SIB 3       | REV 07  | 710-022594  | DW4175        | SIB-TXP-T1600-S     |
| SIB 4       | REV 07  | 710-022594  | DW4209        | SIB-TXP-T1600-S     |
| Fan Tray 0  |         |             |               | FANTRAY-T-S         |
| Fan Tray 1  |         |             |               | FANTRAY-T-S         |
| Fan Tray 2  |         |             |               | FANTRAY-TXP-R-S     |

#### show chassis hardware (TX Matrix Plus Router with 3D SIBs)

user@host> show chassis hardware  
sfc0-re0:

-----  
Hardware inventory:

| Item        | Version | Part number | Serial number | Description     |
|-------------|---------|-------------|---------------|-----------------|
| Chassis     |         |             | JN11CAAA4AHB  | TXP             |
| Midplane    | REV 05  | 710-022574  | ABAC4696      | SFC Midplane    |
| FPM Display | REV 09  | 710-024027  | EH3138        | TXP FPM Display |
| CIP 0       | REV 12  | 710-023792  | EF6349        | TXP CIP         |

|                  |        |            |              |                    |
|------------------|--------|------------|--------------|--------------------|
| CIP 1            | REV 12 | 710-023792 | EG5294       | TXP CIP            |
| PEM 0            | Rev 06 | 740-027463 | XH04595      | Power Entry Module |
| PEM 1            | Rev 06 | 740-027463 | XH04592      | Power Entry Module |
| Routing Engine 0 | REV 07 | 740-026942 | P737A-002541 | RE-DUO-2600        |
| Routing Engine 1 | REV 07 | 740-026942 | P737A-002602 | RE-DUO-2600        |
| CB 0             | REV 15 | 710-022606 | EH4376       | SFC Control Board  |
| CB 1             | REV 15 | 710-022606 | EH4379       | SFC Control Board  |
| SPMB 0           |        | BUILTIN    |              | SFC Switch CPU     |
| SPMB 1           |        | BUILTIN    |              | SFC Switch CPU     |
| SIB F13 0        | REV 10 | 750-035002 | EM9305       | F13 SIB 3D         |
| B Board          | REV 06 | 711-035082 | EM9667       | F13 SIB 3D Mezz    |
| P Board          | REV 05 | 711-043544 | EM9708       | F13 SIB 3D Power   |
| Xcvr 0           | REV 01 | 740-047547 | XB34FB00S    | CXP Module         |
| Xcvr 2           | REV 01 | 740-047547 | XB48FB01H    | CXP Module         |
| Xcvr 4           | REV 01 | 740-047547 | XB34FB02W    | CXP Module         |
| Xcvr 6           | REV 01 | 740-047547 | XB34FB01T    | CXP Module         |
| Xcvr 8           | REV 01 | 740-047547 | XB48FB00W    | CXP Module         |
| Xcvr 10          | REV 01 | 740-047547 | XB34FB01S    | CXP Module         |
| Xcvr 12          | REV 01 | 740-047547 | XB34FB03H    | CXP Module         |
| Xcvr 14          | REV 01 | 740-047547 | XB34FB023    | CXP Module         |
| SIB F13 3        | REV 01 | 710-035001 | EJ2612       | F13 SIB 3D         |
| B Board          | REV 01 | 711-035082 | EJ3815       | F13 SIB 3D Mezz    |
| P Board          | REV 01 | 711-043544 | EJ2678       | F13 SIB 3D Power   |
| Xcvr 0           | REV 01 | 740-047547 | XB48FB04C    | CXP Module         |
| Xcvr 2           | REV 01 | 740-047547 | XB48FB00Z    | CXP Module         |
| Xcvr 4           | REV 01 | 740-047547 | XB47FB036    | CXP Module         |
| Xcvr 6           | REV 01 | 740-047547 | XB47FB029    | CXP Module         |
| Xcvr 8           | REV 01 | 740-047547 | XB48FB02N    | CXP Module         |
| Xcvr 10          | REV 01 | 740-047547 | XB42FB0CS    | CXP Module         |
| Xcvr 12          | REV 01 | 740-047547 | XB47FB01X    | CXP Module         |
| Xcvr 14          | REV 01 | 740-047547 | XB48FB02F    | CXP Module         |
| SIB F13 6        | REV 05 | 750-035002 | EK2675       | F13 SIB 3D         |
| B Board          | REV 03 | 711-035082 | EK2612       | F13 SIB 3D Mezz    |
| P Board          | REV 04 | 711-043544 | EK1179       | F13 SIB 3D Power   |
| Xcvr 0           | REV 01 | 740-047547 | XB48FB01T    | CXP Module         |
| Xcvr 2           | REV 01 | 740-047547 | XB48FB02M    | CXP Module         |
| Xcvr 4           | REV 01 | 740-047547 | XB48FB031    | CXP Module         |
| Xcvr 6           | REV 01 | 740-047547 | XB48FB04P    | CXP Module         |
| Xcvr 8           | REV 01 | 740-047547 | XB48FB02T    | CXP Module         |
| Xcvr 10          | REV 01 | 740-047547 | XB34FB01V    | CXP Module         |
| Xcvr 12          | REV 01 | 740-047547 | XB48FB02C    | CXP Module         |
| Xcvr 14          |        | NON-JNPR   |              | No Module          |
| SIB F13 12       | REV 01 | 710-035001 | EJ2631       | F13 SIB 3D         |
| B Board          | REV 01 | 711-035082 | EJ3808       | F13 SIB 3D Mezz    |
| P Board          | REV 01 | 711-043544 | EJ2676       | F13 SIB 3D Power   |
| SIB F2S 0/0      | REV 01 | 711-034977 | EH9829       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9927       | F2S SIB 3D Mezz    |
| SIB F2S 0/2      | REV 01 | 711-034977 | EH9791       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9852       | F2S SIB 3D Mezz    |
| SIB F2S 0/4      | REV 01 | 711-034977 | EH9803       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9915       | F2S SIB 3D Mezz    |
| SIB F2S 0/6      | REV 01 | 711-034977 | EH9763       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9880       | F2S SIB 3D Mezz    |
| SIB F2S 1/0      | REV 01 | 711-034977 | EH9757       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9889       | F2S SIB 3D Mezz    |
| SIB F2S 1/2      | REV 01 | 711-034977 | EH9815       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EH9890       | F2S SIB 3D Mezz    |
| SIB F2S 1/4      | REV 08 | 750-034978 | EN1954       | F2S SIB 3D         |
| B Board          | REV 02 | 711-034979 | EN1436       | F2S SIB 3D Mezz    |
| SIB F2S 1/6      | REV 01 | 711-034977 | EJ7054       | F2S SIB 3D         |
| B Board          | REV 01 | 711-034979 | EJ8238       | F2S SIB 3D Mezz    |



|             |        |            |        |                 |
|-------------|--------|------------|--------|-----------------|
| SIB F2S 2/0 | REV 01 | 711-034977 | EH9830 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EH9844 | F2S SIB 3D Mezz |
| SIB F2S 2/2 | REV 01 | 711-034977 | EH9818 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EH9888 | F2S SIB 3D Mezz |
| SIB F2S 2/4 | REV 01 | 711-034977 | EH9795 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EH9869 | F2S SIB 3D Mezz |
| SIB F2S 2/6 | REV 01 | 711-034977 | EJ7026 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EJ8273 | F2S SIB 3D Mezz |
| SIB F2S 3/0 | REV 01 | 711-034977 | EH9811 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EH9892 | F2S SIB 3D Mezz |
| SIB F2S 3/2 | REV 01 | 711-034977 | EH9812 | F2S SIB 3D      |
| B Board     | REV 01 | 711-034979 | EH9877 | F2S SIB 3D Mezz |
| SIB F2S 3/4 | REV 08 | 750-034978 | EN1947 | F2S SIB 3D      |
| B Board     | REV 02 | 711-034979 | EN1471 | F2S SIB 3D Mezz |
| Fan Tray 0  | REV 10 | 760-024497 | EH3313 | Front Fan Tray  |
| Fan Tray 1  | REV 10 | 760-024497 | EH3290 | Front Fan Tray  |
| Fan Tray 2  | REV 10 | 760-024502 | EH3292 | Rear Fan Tray   |
| Fan Tray 3  | REV 10 | 760-024502 | EH3287 | Rear Fan Tray   |
| Fan Tray 4  | REV 10 | 760-024502 | EH3286 | Rear Fan Tray   |
| Fan Tray 5  | REV 10 | 760-024502 | EH3285 | Rear Fan Tray   |

```
lcc0-re0:
```

```
-----
Hardware inventory:
```

| Item             | Version | Part number | Serial number | Description             |
|------------------|---------|-------------|---------------|-------------------------|
| Chassis          |         |             | JN1B23FEAHA   | T1600                   |
| Midplane         | REV 01  | 710-027486  | RC9787        | T-series Backplane      |
| FPM GBUS         | REV 13  | 710-002901  | BBAG5132      | T640 FPM Board          |
| FPM Display      | REV 04  | 710-021387  | BBAL9612      | T1600 FPM Display       |
| CIP              | REV 06  | 710-002895  | BBAN0605      | T-series CIP            |
| PEM 0            | REV 05  | 740-036442  | 1G022060143   | Power Entry Module 6x60 |
| PEM 1            | REV 05  | 740-036442  | 1G022060011   | Power Entry Module 6x60 |
| SCG 0            | REV 18  | 710-003423  | BBAL7318      | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18  | 710-003423  | BBAL7255      | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 07  | 740-026941  | P737F-002933  | RE-DUO-1800             |
| Routing Engine 1 | REV 06  | 740-026941  | P737F-002749  | RE-DUO-1800             |
| CB 0             | REV 11  | 710-022597  | EH3611        | LCC Control Board       |
| CB 1             | REV 11  | 710-022597  | EH4798        | LCC Control Board       |
| FPC 5            | REV 17  | 710-013037  | BBAC5333      | FPC Type 4-ES           |
| CPU              | REV 10  | 710-016744  | BBAB7619      | ST-PMB2                 |
| PIC 0            | REV 18  | 750-017405  | BBAE3420      | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0           | REV 03  | 740-014289  | T10C90659     | XFP-10G-SR              |
| MMB 0            | REV 05  | 710-025563  | BBAB9538      | ST-MMB2                 |
| MMB 1            | REV 05  | 710-025563  | BBAB9502      | ST-MMB2                 |
| FPC 7            | REV 01  | 750-045173  | BBAV0032      | FPC Type 5-3D           |
| CPU              |         |             |               |                         |
| SPMB 0           | REV 05  | 710-023321  | EG9434        | LCC Switch CPU          |
| SPMB 1           | REV 05  | 710-023321  | EH3878        | LCC Switch CPU          |
| SIB 0            | REV 01  | 750-041657  | EH7997        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7674        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB014     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB05A     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB052     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB01B     | CXP Module              |
| SIB 1            | REV 01  | 750-041657  | EH8023        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7659        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB05J     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB01E     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB01J     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB02S     | CXP Module              |
| SIB 2            | REV 03  | 750-041657  | EJ6554        | LCC SIB 3D              |

|            |        |            |           |                        |
|------------|--------|------------|-----------|------------------------|
| B Board    | REV 02 | 711-042424 | EJ5756    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB34FB01Z | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB34FB013 | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB04Z | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB05N | CXP Module             |
| Fan Tray 0 |        |            |           | Front Top Fan Tray     |
| Fan Tray 1 |        |            |           | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |           | Rear Fan Tray -- Rev 4 |

lcc2-re0:

-----  
Hardware inventory:

| Item             | Version | Part number | Serial number | Description             |
|------------------|---------|-------------|---------------|-------------------------|
| Chassis          |         |             | JN1B3975AHA   | T1600                   |
| Midplane         | REV 01  | 710-027486  | RC9826        | T-series Backplane      |
| FPM GBUS         | REV 13  | 710-002901  | BBAG5124      | T640 FPM Board          |
| FPM Display      | REV 03  | 710-021387  | BBAJ1112      | T1600 FPM Display       |
| CIP              | REV 06  | 710-002895  | BBAL3744      | T-series CIP            |
| PEM 0            | REV 05  | 740-036442  | 1G022060081   | Power Entry Module 6x60 |
| PEM 1            | REV 05  | 740-036442  | 1G022060188   | Power Entry Module 6x60 |
| SCG 0            | REV 18  | 710-003423  | BBAH8775      | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18  | 710-003423  | BBAL7272      | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 07  | 740-026941  | P737F-002992  | RE-DUO-1800             |
| Routing Engine 1 | REV 07  | 740-026941  | P737F-002938  | RE-DUO-1800             |
| CB 0             | REV 11  | 710-022597  | EH4805        | LCC Control Board       |
| CB 1             | REV 11  | 710-022597  | EH4786        | LCC Control Board       |
| FPC 1            | REV 01  | 710-033873  | BBAH0320      | FPC Type 3-ES           |
| CPU              | REV 11  | 710-016744  | BBAF3281      | ST-PMB2                 |
| MMB 0            | REV 06  | 710-025563  | BBAF5061      | ST-MMB2                 |
| FPC 5            | REV 04  | 710-033871  | BBAM5070      | FPC Type 4-ES           |
| CPU              | REV 11  | 710-016744  | BBAM6653      | ST-PMB2                 |
| PIC 1            | REV 20  | 750-017405  | BBAM1296      | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0           | REV 03  | 740-014289  | T10B42981     | XFP-10G-SR              |
| MMB 0            | REV 07  | 710-025563  | BBAN2631      | ST-MMB2                 |
| MMB 1            | REV 07  | 710-025563  | BBAN2538      | ST-MMB2                 |
| SPMB 0           | REV 05  | 710-023321  | EH3903        | LCC Switch CPU          |
| SPMB 1           | REV 05  | 710-023321  | EH3902        | LCC Switch CPU          |
| SIB 0            | REV 01  | 750-041657  | EH8019        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7680        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB04F     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB04S     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB04B     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB043     | CXP Module              |
| SIB 1            | REV 01  | 750-041657  | EH8012        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7658        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB05E     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB01Z     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB018     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB054     | CXP Module              |
| SIB 2            | REV 01  | 750-041657  | EH7993        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7678        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB05C     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB47FB00N     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB05U     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB05L     | CXP Module              |
| Fan Tray 0       |         |             |               | Front Top Fan Tray      |
| Fan Tray 1       |         |             |               | Front Bottom Fan Tray   |
| Fan Tray 2       |         |             |               | Rear Fan Tray -- Rev 4  |

## show chassis hardware clei-models (TX Matrix Plus Router with 3D SIBs)

```
user@host> show chassis hardware clei-models
sfc0-re0:
```

```
-----
Hardware inventory:
```

| Item             | Version | Part number | CLEI code  | FRU model number   |
|------------------|---------|-------------|------------|--------------------|
| Midplane         | REV 05  | 710-022574  |            | CHAS-BP-TXP-S      |
| FPM Display      | REV 09  | 710-024027  |            | CRAFT-TXP-S        |
| CIP 0            | REV 12  | 710-023792  |            | CIP-TXP-S          |
| CIP 1            | REV 12  | 710-023792  |            | CIP-TXP-S          |
| PEM 0            | Rev 06  | 740-027463  | IPUPAFGKTA | PWR-TXP-7-60-DC-S  |
| Routing Engine 0 | REV 07  | 740-026942  |            | RE-DUO-C2600-16G-S |
| Routing Engine 1 | REV 07  | 740-026942  |            | RE-DUO-C2600-16G-S |
| CB 0             | REV 13  | 710-022606  |            | CB-TXP-S           |
| CB 1             | REV 14  | 710-022606  |            | CB-TXP-S           |
| SIB F13 0        | REV 10  | 750-035002  | PROTOXCLEI | SIB-TXP-3D-F13-S   |
| Xcvr 0           | REV 01  | 740-048813  |            |                    |
| Xcvr 1           | REV 01  | 740-048813  |            |                    |
| Xcvr 2           | REV 01  | 740-048813  |            |                    |
| Xcvr 3           | REV 01  | 740-048813  |            |                    |
| Xcvr 4           | REV 01  | 740-048813  |            |                    |
| Xcvr 5           | REV 01  | 740-048813  |            |                    |
| Xcvr 6           | REV 01  | 740-048813  |            |                    |
| Xcvr 7           | REV 01  | 740-048813  |            |                    |
| Xcvr 8           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 10          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 12          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 14          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| SIB F13 1        | REV 10  | 750-035002  | PROTOXCLEI | SIB-TXP-3D-F13-S   |
| Xcvr 0           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 1           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 2           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 3           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 4           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 5           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 6           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 7           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 8           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 10          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 12          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 14          | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 0           | REV 01  | 740-048813  |            |                    |
| Xcvr 1           | REV 01  | 740-048813  |            |                    |
| Xcvr 2           | REV 01  | 740-048813  |            |                    |
| Xcvr 3           | REV 01  | 740-048813  |            |                    |
| Xcvr 4           | REV 01  | 740-048813  |            |                    |
| Xcvr 5           | REV 01  | 740-048813  |            |                    |
| Xcvr 6           | REV 01  | 740-048813  |            |                    |
| Xcvr 7           | REV 01  | 740-048813  |            |                    |
| Xcvr 8           | REV 01  | 740-048813  |            |                    |
| Xcvr 10          | REV 01  | 740-048813  |            |                    |
| Xcvr 12          | REV 01  | 740-048813  |            |                    |
| Xcvr 14          | REV 01  | 740-048813  |            |                    |
| Xcvr 0           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 1           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 2           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 3           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 4           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 5           | REV 01  | 740-047547  |            | CXP-TXP-3D         |
| Xcvr 6           | REV 01  | 740-047547  |            | CXP-TXP-3D         |

|            |        |            |            |                  |
|------------|--------|------------|------------|------------------|
| Xcvr 7     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 8     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 10    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 12    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 14    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| SIB F13 6  | REV 16 | 750-035002 | PROTOXCLEI | SIB-TXP-3D-F13   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| Xcvr 8     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 10    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 12    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 14    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| SIB F13 7  | REV 10 | 750-035002 | PROTOXCLEI | SIB-TXP-3D-F13-S |
| Xcvr 0     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 1     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 2     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 3     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 4     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 5     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 6     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 7     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 8     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 10    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 12    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 14    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 6     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 7     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 8     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 10    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 12    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 14    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| SIB F13 9  | REV 16 | 750-035002 | PROTOXCLEI | SIB-TXP-3D-F13   |
| Xcvr 0     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 1     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 2     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 3     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 4     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 5     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 6     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 7     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 8     | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 10    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 12    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| Xcvr 14    | REV 01 | 740-047547 |            | CXP-TXP-3D       |
| SIB F13 11 | REV 10 | 750-035002 | PROTOXCLEI | 750-035002       |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |

|             |        |            |            |                 |
|-------------|--------|------------|------------|-----------------|
| Xcvr 4      | REV 01 | 740-048813 |            |                 |
| Xcvr 5      | REV 01 | 740-048813 |            |                 |
| Xcvr 6      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 7      | REV 01 | 740-048813 |            |                 |
| Xcvr 8      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 12     | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 14     | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| SIB F13 12  | REV 16 | 750-035002 | PROTOXCLEI | SIB-TXP-3D-F13  |
| Xcvr 0      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 1      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 2      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 3      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 4      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 5      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 6      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 7      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 8      | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 10     | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 12     | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| Xcvr 14     | REV 01 | 740-047547 |            | CXP-TXP-3D      |
| SIB F2S 0/0 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 0/2 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 0/4 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 0/6 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 1/0 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 1/2 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 1/4 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 1/6 | REV 08 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 2/0 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 2/2 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 2/4 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 2/6 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 3/0 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 3/2 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 3/4 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 3/6 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 4/0 | REV 07 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 4/2 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 4/4 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| SIB F2S 4/6 | REV 06 | 750-034978 | PROTOXCLEI | SIB-TXP-3D-F2S  |
| Fan Tray 0  | REV 10 | 760-024497 |            | FANTRAY-TXP-H-S |
| Fan Tray 1  | REV 10 | 760-024497 |            | FANTRAY-TXP-H-S |
| Fan Tray 2  | REV 10 | 760-024502 |            | FANTRAY-TXP-V-S |
| Fan Tray 3  | REV 10 | 760-024502 |            | FANTRAY-TXP-V-S |
| Fan Tray 4  | REV 10 | 760-024502 |            | FANTRAY-TXP-V-S |
| Fan Tray 5  | REV 10 | 760-024502 |            | FANTRAY-TXP-V-S |

lcc0-re0:

-----  
Hardware inventory:

| Item             | Version | Part number | CLEI code  | FRU model number  |
|------------------|---------|-------------|------------|-------------------|
| Midplane         | REV 01  | 710-027486  | IPMJ700DRD | CHAS-BP-T1600-S   |
| FPM Display      | REV 04  | 710-021387  |            | CRAFT-T1600-S     |
| CIP              | REV 06  | 710-002895  |            | CIP-L-T640-S      |
| PEM 0            | REV 05  | 740-036442  | IPUPAG6KAA | PWR-T-6-60-DC-S   |
| PEM 1            | REV 05  | 740-036442  | IPUPAG6KAA | PWR-T-6-60-DC-S   |
| SCG 0            | REV 18  | 710-003423  |            | SCG-T-S           |
| SCG 1            | REV 18  | 710-003423  |            | SCG-T-S           |
| Routing Engine 0 | REV 10  | 740-026941  |            | RE-DU0-C1800-8G-S |
| Routing Engine 1 | REV 07  | 740-026941  |            | RE-DU0-C1800-8G-S |
| CB 0             | REV 11  | 710-022597  |            | CB-LCC-S          |

|            |        |            |            |                  |
|------------|--------|------------|------------|------------------|
| CB 1       | REV 11 | 710-022597 |            | CB-LCC-S         |
| FPC 0      | REV 01 | 750-045173 | IP9IAL4DAB | T4000-FPC5-3D    |
| PIC 0      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| PIC 1      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| FPC 3      | REV 01 | 750-045173 | IP9IAL4DAB | T4000-FPC5-3D    |
| PIC 0      | REV 13 | 750-033423 | XXXXXXXXDD | PF-12-24XGE-SFPP |
| FPC 4      | REV 02 | 750-045173 | IP9IAL4DAC | T4000-FPC5-3D    |
| PIC 0      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| PIC 1      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| FPC 5      | REV 01 | 750-045173 | IP9IAL4DAB | T4000-FPC5-3D    |
| PIC 0      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| PIC 1      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| FPC 6      | REV 01 | 750-045173 | IP9IAL4DAB | T4000-FPC5-3D    |
| PIC 0      | REV 17 | 750-034624 | IP9IAL2DAA | PF-12XGE-SFPP    |
| PIC 1      | REV 10 | 750-035293 | IP9IAL3DAA | PF-1CGE-CFP      |
| SIB 0      | REV 06 | 750-041657 | PROTOXCLEI | SIB-TXP-3D-LCC   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| SIB 1      | REV 06 | 750-041657 | PROTOXCLEI | SIB-TXP-3D-LCC   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| SIB 2      | REV 06 | 750-041657 | PROTOXCLEI | SIB-TXP-3D-LCC   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| SIB 3      | REV 07 | 750-041657 | PROTOXCLEI | SIB-TXP-3D-LCC   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| SIB 4      | REV 06 | 750-041657 | PROTOXCLEI | SIB-TXP-3D-LCC   |
| Xcvr 0     | REV 01 | 740-048813 |            |                  |
| Xcvr 1     | REV 01 | 740-048813 |            |                  |
| Xcvr 2     | REV 01 | 740-048813 |            |                  |
| Xcvr 3     | REV 01 | 740-048813 |            |                  |
| Xcvr 4     | REV 01 | 740-048813 |            |                  |
| Xcvr 5     | REV 01 | 740-048813 |            |                  |
| Xcvr 6     | REV 01 | 740-048813 |            |                  |
| Xcvr 7     | REV 01 | 740-048813 |            |                  |
| Fan Tray 0 |        |            |            | FANTRAY-T-S      |

Fan Tray 1  
Fan Tray 2  
[Output Truncated]

FANTRAY-T-S  
FANTRAY-TXP3D-LCC-R-S

### show chassis hardware detail (TX Matrix Plus Router with 3D SIBs)

```
user@host> show chassis hardware detail
sfc0-re0:
```

-----  
Hardware inventory:

| Item             | Version  | Part number           | Serial number        | Description        |
|------------------|----------|-----------------------|----------------------|--------------------|
| Chassis          |          |                       | JN11CAAA4AHB         | TXP                |
| Midplane         | REV 05   | 710-022574            | ABAC4696             | SFC Midplane       |
| FPM Display      | REV 09   | 710-024027            | EH3138               | TXP FPM Display    |
| CIP 0            | REV 12   | 710-023792            | EF6349               | TXP CIP            |
| CIP 1            | REV 12   | 710-023792            | EG5294               | TXP CIP            |
| PEM 0            | Rev 06   | 740-027463            | XH04595              | Power Entry Module |
| PEM 1            | Rev 06   | 740-027463            | XH04592              | Power Entry Module |
| Routing Engine 0 | REV 07   | 740-026942            | P737A-002541         | RE-DUO-2600        |
| ad0              | 3823 MB  | SMART CF              | 2011030400062C132C13 | Compact Flash      |
| ad1              | 62720 MB | SMART Lite SATA Drive | 201105100009A452A452 | Disk 1             |
| Routing Engine 1 | REV 07   | 740-026942            | P737A-002602         | RE-DUO-2600        |
| ad0              | 3823 MB  | SMART CF              | 20110508085EE471E471 | Compact Flash      |
| ad1              | 62720 MB | SMART Lite SATA Drive | 201110210089DF39DF39 | Disk 1             |
| CB 0             | REV 15   | 710-022606            | EH4376               | SFC Control Board  |
| CB 1             | REV 15   | 710-022606            | EH4379               | SFC Control Board  |
| SPMB 0           |          | BUILTIN               |                      | SFC Switch CPU     |
| SPMB 1           |          | BUILTIN               |                      | SFC Switch CPU     |
| SIB F13 0        | REV 10   | 750-035002            | EM9305               | F13 SIB 3D         |
| B Board          | REV 06   | 711-035082            | EM9667               | F13 SIB 3D Mezz    |
| P Board          | REV 05   | 711-043544            | EM9708               | F13 SIB 3D Power   |
| Xcvr 0           | REV 01   | 740-047547            | XB34FB00S            | CXP Module         |
| Xcvr 2           | REV 01   | 740-047547            | XB48FB01H            | CXP Module         |
| Xcvr 4           | REV 01   | 740-047547            | XB34FB02W            | CXP Module         |
| Xcvr 6           | REV 01   | 740-047547            | XB34FB01T            | CXP Module         |
| Xcvr 8           | REV 01   | 740-047547            | XB48FB00W            | CXP Module         |
| Xcvr 10          | REV 01   | 740-047547            | XB34FB01S            | CXP Module         |
| Xcvr 12          | REV 01   | 740-047547            | XB34FB03H            | CXP Module         |
| Xcvr 14          | REV 01   | 740-047547            | XB34FB023            | CXP Module         |
| SIB F13 3        | REV 01   | 710-035001            | EJ2612               | F13 SIB 3D         |
| B Board          | REV 01   | 711-035082            | EJ3815               | F13 SIB 3D Mezz    |
| P Board          | REV 01   | 711-043544            | EJ2678               | F13 SIB 3D Power   |
| Xcvr 0           | REV 01   | 740-047547            | XB48FB04C            | CXP Module         |
| Xcvr 2           | REV 01   | 740-047547            | XB48FB00Z            | CXP Module         |
| Xcvr 4           | REV 01   | 740-047547            | XB47FB036            | CXP Module         |
| Xcvr 6           | REV 01   | 740-047547            | XB47FB029            | CXP Module         |
| Xcvr 8           | REV 01   | 740-047547            | XB48FB02N            | CXP Module         |
| Xcvr 10          | REV 01   | 740-047547            | XB42FB0CS            | CXP Module         |
| Xcvr 12          | REV 01   | 740-047547            | XB47FB01X            | CXP Module         |
| Xcvr 14          | REV 01   | 740-047547            | XB48FB02F            | CXP Module         |
| SIB F13 6        | REV 05   | 750-035002            | EK2675               | F13 SIB 3D         |
| B Board          | REV 03   | 711-035082            | EK2612               | F13 SIB 3D Mezz    |
| P Board          | REV 04   | 711-043544            | EK1179               | F13 SIB 3D Power   |
| Xcvr 0           | REV 01   | 740-047547            | XB48FB01T            | CXP Module         |
| Xcvr 2           | REV 01   | 740-047547            | XB48FB02M            | CXP Module         |
| Xcvr 4           | REV 01   | 740-047547            | XB48FB031            | CXP Module         |
| Xcvr 6           | REV 01   | 740-047547            | XB48FB04P            | CXP Module         |
| Xcvr 8           | REV 01   | 740-047547            | XB48FB02T            | CXP Module         |
| Xcvr 10          | REV 01   | 740-047547            | XB34FB01V            | CXP Module         |
| Xcvr 12          | REV 01   | 740-047547            | XB48FB02C            | CXP Module         |
| Xcvr 14          |          | NON-JNPR              |                      | No Module          |

|             |        |            |        |                  |
|-------------|--------|------------|--------|------------------|
| SIB F13 12  | REV 01 | 710-035001 | EJ2631 | F13 SIB 3D       |
| B Board     | REV 01 | 711-035082 | EJ3808 | F13 SIB 3D Mezz  |
| P Board     | REV 01 | 711-043544 | EJ2676 | F13 SIB 3D Power |
| SIB F2S 0/0 | REV 01 | 711-034977 | EH9829 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9927 | F2S SIB 3D Mezz  |
| SIB F2S 0/2 | REV 01 | 711-034977 | EH9791 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9852 | F2S SIB 3D Mezz  |
| SIB F2S 0/4 | REV 01 | 711-034977 | EH9803 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9915 | F2S SIB 3D Mezz  |
| SIB F2S 0/6 | REV 01 | 711-034977 | EH9763 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9880 | F2S SIB 3D Mezz  |
| SIB F2S 1/0 | REV 01 | 711-034977 | EH9757 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9889 | F2S SIB 3D Mezz  |
| SIB F2S 1/2 | REV 01 | 711-034977 | EH9815 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9890 | F2S SIB 3D Mezz  |
| SIB F2S 1/4 | REV 08 | 750-034978 | EN1954 | F2S SIB 3D       |
| B Board     | REV 02 | 711-034979 | EN1436 | F2S SIB 3D Mezz  |
| SIB F2S 1/6 | REV 01 | 711-034977 | EJ7054 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EJ8238 | F2S SIB 3D Mezz  |
| SIB F2S 2/0 | REV 01 | 711-034977 | EH9830 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9844 | F2S SIB 3D Mezz  |
| SIB F2S 2/2 | REV 01 | 711-034977 | EH9818 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9888 | F2S SIB 3D Mezz  |
| SIB F2S 2/4 | REV 01 | 711-034977 | EH9795 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9869 | F2S SIB 3D Mezz  |
| SIB F2S 2/6 | REV 01 | 711-034977 | EJ7026 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EJ8273 | F2S SIB 3D Mezz  |
| SIB F2S 3/0 | REV 01 | 711-034977 | EH9811 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9892 | F2S SIB 3D Mezz  |
| SIB F2S 3/2 | REV 01 | 711-034977 | EH9812 | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9877 | F2S SIB 3D Mezz  |
| SIB F2S 3/4 | REV 08 | 750-034978 | EN1947 | F2S SIB 3D       |
| B Board     | REV 02 | 711-034979 | EN1471 | F2S SIB 3D Mezz  |
| Fan Tray 0  | REV 10 | 760-024497 | EH3313 | Front Fan Tray   |
| Fan Tray 1  | REV 10 | 760-024497 | EH3290 | Front Fan Tray   |
| Fan Tray 2  | REV 10 | 760-024502 | EH3292 | Rear Fan Tray    |
| Fan Tray 3  | REV 10 | 760-024502 | EH3287 | Rear Fan Tray    |
| Fan Tray 4  | REV 10 | 760-024502 | EH3286 | Rear Fan Tray    |
| Fan Tray 5  | REV 10 | 760-024502 | EH3285 | Rear Fan Tray    |

1cc0-re0:

-----  
Hardware inventory:

| Item             | Version  | Part number           | Serial number        | Description             |
|------------------|----------|-----------------------|----------------------|-------------------------|
| Chassis          |          |                       | JN11B23FEAHA         | T1600                   |
| Midplane         | REV 01   | 710-027486            | RC9787               | T-series Backplane      |
| FPM GBUS         | REV 13   | 710-002901            | BBAG5132             | T640 FPM Board          |
| FPM Display      | REV 04   | 710-021387            | BBAL9612             | T1600 FPM Display       |
| CIP              | REV 06   | 710-002895            | BBAN0605             | T-series CIP            |
| PEM 0            | REV 05   | 740-036442            | 1G022060143          | Power Entry Module 6x60 |
| PEM 1            | REV 05   | 740-036442            | 1G022060011          | Power Entry Module 6x60 |
| SCG 0            | REV 18   | 710-003423            | BBAL7318             | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18   | 710-003423            | BBAL7255             | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 07   | 740-026941            | P737F-002933         | RE-DUO-1800             |
| ad0              | 3823 MB  | SMART CF              | 201103030490604E604E | Compact Flash           |
| ad1              | 62720 MB | SMART Lite SATA Drive | 20110729028B11D411D4 | Disk 1                  |
| Routing Engine 1 | REV 06   | 740-026941            | P737F-002749         | RE-DUO-1800             |
| ad0              | 3823 MB  | SMART CF              | 2011010504EB99649964 | Compact Flash           |
| ad1              | 62720 MB | SMART Lite SATA Drive | 201102140058934A934A | Disk 1                  |
| CB 0             | REV 11   | 710-022597            | EH3611               | LCC Control Board       |
| CB 1             | REV 11   | 710-022597            | EH4798               | LCC Control Board       |



|            |        |            |           |                        |
|------------|--------|------------|-----------|------------------------|
| FPC 5      | REV 17 | 710-013037 | BBAC5333  | FPC Type 4-ES          |
| CPU        | REV 10 | 710-016744 | BBAB7619  | ST-PMB2                |
| PIC 0      | REV 18 | 750-017405 | BBAE3420  | 4x 10GE (LAN/WAN) XFP  |
| Xcvr 0     | REV 03 | 740-014289 | T10C90659 | XFP-10G-SR             |
| MMB 0      | REV 05 | 710-025563 | BBAB9538  | ST-MMB2                |
| MMB 1      | REV 05 | 710-025563 | BBAB9502  | ST-MMB2                |
| FPC 7      | REV 01 | 750-045173 | BBAV0032  | FPC Type 5-3D          |
| CPU        |        |            |           |                        |
| SPMB 0     | REV 05 | 710-023321 | EG9434    | LCC Switch CPU         |
| SPMB 1     | REV 05 | 710-023321 | EH3878    | LCC Switch CPU         |
| SIB 0      | REV 01 | 750-041657 | EH7997    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7674    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB014 | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB48FB05A | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB052 | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB01B | CXP Module             |
| SIB 1      | REV 01 | 750-041657 | EH8023    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7659    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB05J | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB48FB01E | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB01J | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB02S | CXP Module             |
| SIB 2      | REV 03 | 750-041657 | EJ6554    | LCC SIB 3D             |
| B Board    | REV 02 | 711-042424 | EJ5756    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB34FB01Z | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB34FB013 | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB04Z | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB05N | CXP Module             |
| Fan Tray 0 |        |            |           | Front Top Fan Tray     |
| Fan Tray 1 |        |            |           | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |           | Rear Fan Tray -- Rev 4 |

lcc2-re0:

-----  
Hardware inventory:

| Item             | Version               | Part number | Serial number        | Description             |
|------------------|-----------------------|-------------|----------------------|-------------------------|
| Chassis          |                       |             | JN11B3975AHA         | T1600                   |
| Midplane         | REV 01                | 710-027486  | RC9826               | T-series Backplane      |
| FPM GBUS         | REV 13                | 710-002901  | BBAG5124             | T640 FPM Board          |
| FPM Display      | REV 03                | 710-021387  | BBAJ1112             | T1600 FPM Display       |
| CIP              | REV 06                | 710-002895  | BBAL3744             | T-series CIP            |
| PEM 0            | REV 05                | 740-036442  | 1G022060081          | Power Entry Module 6x60 |
| PEM 1            | REV 05                | 740-036442  | 1G022060188          | Power Entry Module 6x60 |
| SCG 0            | REV 18                | 710-003423  | BBAH8775             | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18                | 710-003423  | BBAL7272             | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 07                | 740-026941  | P737F-002992         | RE-DUO-1800             |
| ad0 3823 MB      | SMART CF              |             | 201103030356329E329E | Compact Flash           |
| ad1 62720 MB     | SMART Lite SATA Drive |             | 2011051000488D8B8D8B | Disk 1                  |
| Routing Engine 1 | REV 07                | 740-026941  | P737F-002938         | RE-DUO-1800             |
| ad0 3823 MB      | SMART CF              |             | 20110304000F02680268 | Compact Flash           |
| ad1 62720 MB     | SMART Lite SATA Drive |             | 201105300A70F325F325 | Disk 1                  |
| CB 0             | REV 11                | 710-022597  | EH4805               | LCC Control Board       |
| CB 1             | REV 11                | 710-022597  | EH4786               | LCC Control Board       |
| FPC 1            | REV 01                | 710-033873  | BBAH0320             | FPC Type 3-ES           |
| CPU              | REV 11                | 710-016744  | BBAF3281             | ST-PMB2                 |
| MMB 0            | REV 06                | 710-025563  | BBAF5061             | ST-MMB2                 |
| FPC 5            | REV 04                | 710-033871  | BBAM5070             | FPC Type 4-ES           |
| CPU              | REV 11                | 710-016744  | BBAM6653             | ST-PMB2                 |
| PIC 1            | REV 20                | 750-017405  | BBAM1296             | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0           | REV 03                | 740-014289  | T10B42981            | XFP-10G-SR              |
| MMB 0            | REV 07                | 710-025563  | BBAN2631             | ST-MMB2                 |

|            |        |            |           |                        |
|------------|--------|------------|-----------|------------------------|
| MMB 1      | REV 07 | 710-025563 | BBAN2538  | ST-MMB2                |
| SPMB 0     | REV 05 | 710-023321 | EH3903    | LCC Switch CPU         |
| SPMB 1     | REV 05 | 710-023321 | EH3902    | LCC Switch CPU         |
| SIB 0      | REV 01 | 750-041657 | EH8019    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7680    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB04F | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB48FB04S | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB04B | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB043 | CXP Module             |
| SIB 1      | REV 01 | 750-041657 | EH8012    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7658    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB05E | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB48FB01Z | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB018 | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB054 | CXP Module             |
| SIB 2      | REV 01 | 750-041657 | EH7993    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7678    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB05C | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB47FB00N | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB05U | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB05L | CXP Module             |
| Fan Tray 0 |        |            |           | Front Top Fan Tray     |
| Fan Tray 1 |        |            |           | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |           | Rear Fan Tray -- Rev 4 |

#### show chassis hardware lcc (TX Matrix Plus Router with 3D SIBs)

```
user@host> show chassis hardware lcc 0
lcc0-re0:
```

##### Hardware inventory:

| Item             | Version | Part number | Serial number | Description             |
|------------------|---------|-------------|---------------|-------------------------|
| Chassis          |         |             | JN11B23FEAHA  | T1600                   |
| Midplane         | REV 01  | 710-027486  | RC9787        | T-series Backplane      |
| FPM GBUS         | REV 13  | 710-002901  | BBAG5132      | T640 FPM Board          |
| FPM Display      | REV 04  | 710-021387  | BBAL9612      | T1600 FPM Display       |
| CIP              | REV 06  | 710-002895  | BBAN0605      | T-series CIP            |
| PEM 0            | REV 05  | 740-036442  | 1G022060143   | Power Entry Module 6x60 |
| PEM 1            | REV 05  | 740-036442  | 1G022060011   | Power Entry Module 6x60 |
| SCG 0            | REV 18  | 710-003423  | BBAL7318      | T640 Sonet Clock Gen.   |
| SCG 1            | REV 18  | 710-003423  | BBAL7255      | T640 Sonet Clock Gen.   |
| Routing Engine 0 | REV 07  | 740-026941  | P737F-002933  | RE-DUO-1800             |
| Routing Engine 1 | REV 06  | 740-026941  | P737F-002749  | RE-DUO-1800             |
| CB 0             | REV 11  | 710-022597  | EH3611        | LCC Control Board       |
| CB 1             | REV 11  | 710-022597  | EH4798        | LCC Control Board       |
| FPC 5            | REV 17  | 710-013037  | BBAC5333      | FPC Type 4-ES           |
| CPU              | REV 10  | 710-016744  | BBAB7619      | ST-PMB2                 |
| PIC 0            | REV 18  | 750-017405  | BBAE3420      | 4x 10GE (LAN/WAN) XFP   |
| Xcvr 0           | REV 03  | 740-014289  | T10C90659     | XFP-10G-SR              |
| MMB 0            | REV 05  | 710-025563  | BBAB9538      | ST-MMB2                 |
| MMB 1            | REV 05  | 710-025563  | BBAB9502      | ST-MMB2                 |
| FPC 7            | REV 01  | 750-045173  | BBAV0032      | FPC Type 5-3D           |
| CPU              |         |             |               |                         |
| SPMB 0           | REV 05  | 710-023321  | EG9434        | LCC Switch CPU          |
| SPMB 1           | REV 05  | 710-023321  | EH3878        | LCC Switch CPU          |
| SIB 0            | REV 01  | 750-041657  | EH7997        | LCC SIB 3D              |
| B Board          | REV 01  | 711-042424  | EH7674        | LCC SIB 3D Mezz         |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB014     | CXP Module              |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB05A     | CXP Module              |
| Xcvr 4           | REV 01  | 740-047547  | XB48FB052     | CXP Module              |
| Xcvr 6           | REV 01  | 740-047547  | XB48FB01B     | CXP Module              |

|            |        |            |           |                        |
|------------|--------|------------|-----------|------------------------|
| SIB 1      | REV 01 | 750-041657 | EH8023    | LCC SIB 3D             |
| B Board    | REV 01 | 711-042424 | EH7659    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB48FB05J | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB48FB01E | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB01J | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB02S | CXP Module             |
| SIB 2      | REV 03 | 750-041657 | EJ6554    | LCC SIB 3D             |
| B Board    | REV 02 | 711-042424 | EJ5756    | LCC SIB 3D Mezz        |
| Xcvr 0     | REV 01 | 740-047547 | XB34FB01Z | CXP Module             |
| Xcvr 2     | REV 01 | 740-047547 | XB34FB013 | CXP Module             |
| Xcvr 4     | REV 01 | 740-047547 | XB48FB04Z | CXP Module             |
| Xcvr 6     | REV 01 | 740-047547 | XB48FB05N | CXP Module             |
| Fan Tray 0 |        |            |           | Front Top Fan Tray     |
| Fan Tray 1 |        |            |           | Front Bottom Fan Tray  |
| Fan Tray 2 |        |            |           | Rear Fan Tray -- Rev 4 |

### show chassis hardware sfc (TX Matrix Plus Router with 3D SIBs)

```
user@host> show chassis hardware sfc 0
sfc0-re0:
```

#### Hardware inventory:

| Item             | Version | Part number | Serial number | Description        |
|------------------|---------|-------------|---------------|--------------------|
| Chassis          |         |             | JN11CAAA4AHB  | TXP                |
| Midplane         | REV 05  | 710-022574  | ABAC4696      | SFC Midplane       |
| FPM Display      | REV 09  | 710-024027  | EH3138        | TXP FPM Display    |
| CIP 0            | REV 12  | 710-023792  | EF6349        | TXP CIP            |
| CIP 1            | REV 12  | 710-023792  | EG5294        | TXP CIP            |
| PEM 0            | Rev 06  | 740-027463  | XH04595       | Power Entry Module |
| PEM 1            | Rev 06  | 740-027463  | XH04592       | Power Entry Module |
| Routing Engine 0 | REV 07  | 740-026942  | P737A-002541  | RE-DUO-2600        |
| Routing Engine 1 | REV 07  | 740-026942  | P737A-002602  | RE-DUO-2600        |
| CB 0             | REV 15  | 710-022606  | EH4376        | SFC Control Board  |
| CB 1             | REV 15  | 710-022606  | EH4379        | SFC Control Board  |
| SPMB 0           |         | BUILTIN     |               | SFC Switch CPU     |
| SPMB 1           |         | BUILTIN     |               | SFC Switch CPU     |
| SIB F13 0        | REV 10  | 750-035002  | EM9305        | F13 SIB 3D         |
| B Board          | REV 06  | 711-035082  | EM9667        | F13 SIB 3D Mezz    |
| P Board          | REV 05  | 711-043544  | EM9708        | F13 SIB 3D Power   |
| Xcvr 0           | REV 01  | 740-047547  | XB34FB00S     | CXP Module         |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB01H     | CXP Module         |
| Xcvr 4           | REV 01  | 740-047547  | XB34FB02W     | CXP Module         |
| Xcvr 6           | REV 01  | 740-047547  | XB34FB01T     | CXP Module         |
| Xcvr 8           | REV 01  | 740-047547  | XB48FB00W     | CXP Module         |
| Xcvr 10          | REV 01  | 740-047547  | XB34FB01S     | CXP Module         |
| Xcvr 12          | REV 01  | 740-047547  | XB34FB03H     | CXP Module         |
| Xcvr 14          | REV 01  | 740-047547  | XB34FB023     | CXP Module         |
| SIB F13 3        | REV 01  | 710-035001  | EJ2612        | F13 SIB 3D         |
| B Board          | REV 01  | 711-035082  | EJ3815        | F13 SIB 3D Mezz    |
| P Board          | REV 01  | 711-043544  | EJ2678        | F13 SIB 3D Power   |
| Xcvr 0           | REV 01  | 740-047547  | XB48FB04C     | CXP Module         |
| Xcvr 2           | REV 01  | 740-047547  | XB48FB00Z     | CXP Module         |
| Xcvr 4           | REV 01  | 740-047547  | XB47FB036     | CXP Module         |
| Xcvr 6           | REV 01  | 740-047547  | XB47FB029     | CXP Module         |
| Xcvr 8           | REV 01  | 740-047547  | XB48FB02N     | CXP Module         |
| Xcvr 10          | REV 01  | 740-047547  | XB42FB0CS     | CXP Module         |
| Xcvr 12          | REV 01  | 740-047547  | XB47FB01X     | CXP Module         |
| Xcvr 14          | REV 01  | 740-047547  | XB48FB02F     | CXP Module         |
| SIB F13 6        | REV 05  | 750-035002  | EK2675        | F13 SIB 3D         |
| B Board          | REV 03  | 711-035082  | EK2612        | F13 SIB 3D Mezz    |
| P Board          | REV 04  | 711-043544  | EK1179        | F13 SIB 3D Power   |

|             |        |            |           |                  |
|-------------|--------|------------|-----------|------------------|
| Xcvr 0      | REV 01 | 740-047547 | XB48FB01T | CXP Module       |
| Xcvr 2      | REV 01 | 740-047547 | XB48FB02M | CXP Module       |
| Xcvr 4      | REV 01 | 740-047547 | XB48FB031 | CXP Module       |
| Xcvr 6      | REV 01 | 740-047547 | XB48FB04P | CXP Module       |
| Xcvr 8      | REV 01 | 740-047547 | XB48FB02T | CXP Module       |
| Xcvr 10     | REV 01 | 740-047547 | XB34FB01V | CXP Module       |
| Xcvr 12     | REV 01 | 740-047547 | XB48FB02C | CXP Module       |
| Xcvr 14     |        | NON-JNPR   |           | No Module        |
| SIB F13 12  | REV 01 | 710-035001 | EJ2631    | F13 SIB 3D       |
| B Board     | REV 01 | 711-035082 | EJ3808    | F13 SIB 3D Mezz  |
| P Board     | REV 01 | 711-043544 | EJ2676    | F13 SIB 3D Power |
| SIB F2S 0/0 | REV 01 | 711-034977 | EH9829    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9927    | F2S SIB 3D Mezz  |
| SIB F2S 0/2 | REV 01 | 711-034977 | EH9791    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9852    | F2S SIB 3D Mezz  |
| SIB F2S 0/4 | REV 01 | 711-034977 | EH9803    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9915    | F2S SIB 3D Mezz  |
| SIB F2S 0/6 | REV 01 | 711-034977 | EH9763    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9880    | F2S SIB 3D Mezz  |
| SIB F2S 1/0 | REV 01 | 711-034977 | EH9757    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9889    | F2S SIB 3D Mezz  |
| SIB F2S 1/2 | REV 01 | 711-034977 | EH9815    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9890    | F2S SIB 3D Mezz  |
| SIB F2S 1/4 | REV 08 | 750-034978 | EN1954    | F2S SIB 3D       |
| B Board     | REV 02 | 711-034979 | EN1436    | F2S SIB 3D Mezz  |
| SIB F2S 1/6 | REV 01 | 711-034977 | EJ7054    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EJ8238    | F2S SIB 3D Mezz  |
| SIB F2S 2/0 | REV 01 | 711-034977 | EH9830    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9844    | F2S SIB 3D Mezz  |
| SIB F2S 2/2 | REV 01 | 711-034977 | EH9818    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9888    | F2S SIB 3D Mezz  |
| SIB F2S 2/4 | REV 01 | 711-034977 | EH9795    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9869    | F2S SIB 3D Mezz  |
| SIB F2S 2/6 | REV 01 | 711-034977 | EJ7026    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EJ8273    | F2S SIB 3D Mezz  |
| SIB F2S 3/0 | REV 01 | 711-034977 | EH9811    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9892    | F2S SIB 3D Mezz  |
| SIB F2S 3/2 | REV 01 | 711-034977 | EH9812    | F2S SIB 3D       |
| B Board     | REV 01 | 711-034979 | EH9877    | F2S SIB 3D Mezz  |
| SIB F2S 3/4 | REV 08 | 750-034978 | EN1947    | F2S SIB 3D       |
| B Board     | REV 02 | 711-034979 | EN1471    | F2S SIB 3D Mezz  |
| Fan Tray 0  | REV 10 | 760-024497 | EH3313    | Front Fan Tray   |
| Fan Tray 1  | REV 10 | 760-024497 | EH3290    | Front Fan Tray   |
| Fan Tray 2  | REV 10 | 760-024502 | EH3292    | Rear Fan Tray    |
| Fan Tray 3  | REV 10 | 760-024502 | EH3287    | Rear Fan Tray    |
| Fan Tray 4  | REV 10 | 760-024502 | EH3286    | Rear Fan Tray    |
| Fan Tray 5  | REV 10 | 760-024502 | EH3285    | Rear Fan Tray    |

### show chassis hardware (16-Port 10-Gigabit Ethernet MPC with SFP+ Optics [MX Series Routers])

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item      | Version | Part number | Serial number | Description          |
|-----------|---------|-------------|---------------|----------------------|
| Chassis   |         |             | JN112D865AFA  | MX960                |
| Midplane  | REV 03  | 710-013698  | TS3339        | MX960 Backplane      |
| FPM Board | REV 03  | 710-014974  | WW6267        | Front Panel Display  |
| PDM       | Rev 03  | 740-013110  | QCS12485026   | Power Distribution   |
| Module    |         |             |               |                      |
| PEM 0     | Rev 04  | 740-013682  | QCS12434086   | PS 1.7kW; 200-240VAC |
| in        |         |             |               |                      |

```

in PEM 1          Rev 04  740-013682  QCS1243408Z  PS 1.7kW; 200-240VAC
in PEM 2          Rev 04  740-013682  QCS1243407X  PS 1.7kW; 200-240VAC
Routing Engine 0 REV 07  740-015113  9009009677   RE-S-1300
Routing Engine 1 REV 07  740-015113  9009011510   RE-S-1300
CB 0              REV 03  710-021523  XF0394       MX SCB
CB 1              REV 03  710-021523  XF0550       MX SCB
CB 2              REV 03  710-021523  XD7455       MX SCB
FPC 4             REV 02  750-028467  JR6127       MPC M 16x 10GE
CPU              REV 02  711-029089  JX0129       AS PMB
PIC 0             BUILTIN  BUILTIN      4x 10GE(LAN) SFP+
PIC 1             BUILTIN  BUILTIN      4x 10GE(LAN) SFP+
PIC 2             BUILTIN  BUILTIN      4x 10GE(LAN) SFP+
PIC 3             BUILTIN  BUILTIN      4x 10GE(LAN) SFP+
Fan Tray 0        REV 05  740-014971  TP9990       Fan Tray
Fan Tray 1        REV 05  740-014971  VS1709       Fan Tray

```

### show chassis hardware (MPC3E [MX Series Routers])

```
user@host> show chassis hardware
```

```
Hardware inventory:
```

| Item             | Version     | Part number | Serial number | Description            |
|------------------|-------------|-------------|---------------|------------------------|
| Chassis          |             |             | JN1101AFEAFB  | MX480                  |
| Midplane         | REV 05      | 710-017414  | TR4444        | MX480 Midplane         |
| FPM Board        | REV 02      | 710-017254  | KG6056        | Front Panel Display    |
| PEM 0            | Rev 03      | 740-017330  | QCS082090FC   | PS 1.2-1.7kW; 100-240V |
| PEM 1            | Rev 03      | 740-017330  | QCS082090FD   | PS 1.2-1.7kW; 100-240V |
| Routing Engine 0 | REV 07      | 740-013063  | 9009004124    | RE-S-2000              |
| Routing Engine 1 | REV 07      | 740-013063  | 9009005569    | RE-S-2000              |
| CB 0             | REV 07      | 710-021523  | XZ3587        | MX SCB                 |
| CB 1             | REV 03      | 710-021523  | KH8306        | MX SCB                 |
| FPC 1            | REV 04.1.07 | 750-033205  | P1240         | MPC Type 3             |
| CPU              | REV 01      | 711-035209  | YL0504        | HMPC PMB 2G            |
| MIC 1            | REV 10      | 750-033199  | YX4495        | 1X100GE CFP            |
| PIC 2            |             | BUILTIN     | BUILTIN       | 1X100GE CFP            |
| Xcvr 0           | REV 01      | 740-032210  | C22CQNE       | CFP-100G-LR4           |
| FPC 2            | REV 26      | 750-016670  | KH0045        | DPCE 40x 1GE R EQ      |
| CPU              | REV 07      | 710-013713  | KF5448        | DPC PMB                |
| PIC 0            |             | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| Xcvr 0           | REV 01      | 740-011613  | PF21JHU       | SFP-SX                 |
| PIC 1            |             | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| Xcvr 9           | REV 01      | 740-011613  | AM0813S8ZL6   | SFP-SX                 |
| PIC 2            |             | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| Xcvr 0           | REV 02      | 740-011613  | PGL2KYF       | SFP-SX                 |
| Xcvr 2           | REV 01      | 740-011613  | AM0806S8N4P   | SFP-SX                 |
| PIC 3            |             | BUILTIN     | BUILTIN       | 10x 1GE(LAN) EQ        |
| Xcvr 5           | REV 01      | 740-011613  | AM0815S967N   | SFP-SX                 |
| Xcvr 7           | REV 01      | 740-011613  | AM0806S8N1X   | SFP-SX                 |
| Xcvr 8           | REV 01      | 740-011613  | AM0815S967J   | SFP-SX                 |
| Xcvr 9           | REV 01      | 740-011613  | AM0815S967M   | SFP-SX                 |
| FPC 3            | REV 12.2.09 | 750-033205  | YR9443        | MPC Type 3             |
| CPU              | REV 03      | 711-035209  | YL6931        | HMPC PMB 2G            |
| MIC 0            | REV 05      | 750-033199  | YR3269        | 1X100GE CFP            |
| PIC 0            |             | BUILTIN     | BUILTIN       | 1X100GE CFP            |
| Xcvr 0           | REV 01      | 740-032210  | ULH0KG3       | CFP-100G-LR4           |
| MIC 1            | REV 02      | 750-033199  | YG3245        | 1X100GE CFP            |
| PIC 2            |             | BUILTIN     | BUILTIN       | 1X100GE CFP            |

|          |             |            |             |                     |
|----------|-------------|------------|-------------|---------------------|
| Xcvr 0   | REV 01      | 740-032210 | ULH0KGF     | CFP-100G-LR4        |
| FPC 4    | REV 12.3.09 | 750-033205 | YR9437      | MPC Type 3          |
| CPU      | REV 03      | 711-035209 | YT5857      | HMPC PMB 2G         |
| MIC 0    | REV 05      | 750-033199 | YR3295      | 1X100GE CFP         |
| PIC 0    |             | BUILTIN    | BUILTIN     | 1X100GE CFP         |
| Xcvr 0   |             | NON-JNPR   | X12000187   | CFP-100G-SR10       |
| MIC 1    | REV 10      | 750-033199 | YX4518      | 1X100GE CFP         |
| PIC 2    |             | BUILTIN    | BUILTIN     | 1X100GE CFP         |
| Xcvr 0   | REV 01      | 740-035329 | X12J00008   | CFP-100G-SR10       |
| FPC 5    | REV 06      | 750-024884 | JW9769      | MPC Type 2 3D EQ    |
| CPU      | REV 02      | 711-028401 | JR6158      | MPC PMB 2G Proto    |
| MIC 0    | REV 05      | 750-028387 | JR6197      | 3D 4x 10GE XFP      |
| PIC 0    |             | BUILTIN    | BUILTIN     | 2x 10GE XFP         |
| Xcvr 0   | REV 01      | 740-014289 | T07M71112   | XFP-10G-SR          |
| Xcvr 1   | REV 02      | 740-014289 | T08L85610   | XFP-10G-SR          |
| PIC 1    |             | BUILTIN    | BUILTIN     | 2x 10GE XFP         |
| MIC 1    | REV 22      | 750-028392 | YM0053      | 3D 20x 1GE(LAN) SFP |
| PIC 2    |             | BUILTIN    | BUILTIN     | 10x 1GE(LAN) SFP    |
| Xcvr 0   | REV 01      | 740-011613 | AM0703S005B | SFP-SX              |
| Xcvr 1   | REV 01      | 740-011613 | E07L01352   | SFP-SX              |
| PIC 3    |             | BUILTIN    | BUILTIN     | 10x 1GE(LAN) SFP    |
| Xcvr 5   | REV 01      | 740-013111 | 6500217     | SFP-T               |
| Xcvr 9   | REV 02      | 740-013111 | 8499527     | SFP-T               |
| Fan Tray |             |            |             | Left Fan Tray       |

The PIC number for MIC 1 always starts from 2 (even if the first MIC is a 1X100GE CFP or a legacy MIC).

#### show chassis hardware (QFX3500 Switches)

```

user@switch> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               QFX3500
Routing Engine 0                               QFX Routing Engine
FPC 0          REV 04    750-044071   BBAR3902      QFX3500-48S4Q-AFI
CPU            BUILTIN   BUILTIN     BUILTIN       FPC CPU
PIC 0          BUILTIN   BUILTIN     BUILTIN       48x 10G-SFP+
PIC 1          BUILTIN   BUILTIN     BUILTIN       15x 10G-SFP+
MGMT BRD       REV 02    750-044063   BBAR0398      QFX3500-MGMT-SFP-AF0
Xcvr 0         REV 01    740-011614   AC0946S0BD1   SFP-LX10
Xcvr 1         REV 02    740-013111   A281922       SFP-T
Power Supply 0 Rev 04    740-032091   UI00677       JPSU-650W-AC-AFI
Power Supply 1 REV 00    740-041741   VJ00162       JPSU-650W-AC-AF0
Fan Tray 0                               QFX Fan Tray, Back to
Front Airflow
Fan Tray 1                               QFX Fan Tray, Back to
Front Airflow
Fan Tray 2                               QFX Fan Tray, Back to
Front Airflow

```

#### show chassis hardware detail (QFX3500 Switches)

```

user@switch> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               QFX3500
Routing Engine 0                               QFX Routing Engine
FPC 0          REV 05    750-036931   EE0823        QFX3500-48S4Q-AFI

```

| CPU            |        | BUILTIN    | BUILTIN    | FPC CPU        |
|----------------|--------|------------|------------|----------------|
| PIC 0          |        | BUILTIN    | BUILTIN    | 48x 10G-SFP+   |
| Xcvr 0         | REV 01 | 740-030589 | S99E270079 | SFP+-10G-LPBK  |
| Xcvr 1         | REV 01 | 740-030589 | S9AK450099 | SFP+-10G-LPBK  |
| Xcvr 2         | REV 01 | 740-030589 | S99E270078 | SFP+-10G-LPBK  |
| Xcvr 3         | REV 01 | 740-030589 | S9AK450098 | SFP+-10G-LPBK  |
| Xcvr 4         | REV 01 | 740-030589 | S99E270075 | SFP+-10G-LPBK  |
| Xcvr 5         | REV 01 | 740-030589 | S9AK450093 | SFP+-10G-LPBK  |
| Xcvr 6         | REV 01 | 740-030589 | S9AK450097 | SFP+-10G-LPBK  |
| Xcvr 7         | REV 01 | 740-030589 | S9AK450095 | SFP+-10G-LPBK  |
| Xcvr 8         | REV 01 | 740-030589 | S99E270072 | SFP+-10G-LPBK  |
| Xcvr 9         | REV 01 | 740-030589 | S99E270073 | SFP+-10G-LPBK  |
| Xcvr 10        | REV 01 | 740-030589 | S99E270080 | SFP+-10G-LPBK  |
| Xcvr 11        | REV 01 | 740-030589 | S9AK450169 | SFP+-10G-LPBK  |
| Xcvr 12        | REV 01 | 740-030589 | S99E270076 | SFP+-10G-LPBK  |
| Xcvr 13        | REV 01 | 740-030589 | S9AK450167 | SFP+-10G-LPBK  |
| Xcvr 14        | REV 01 | 740-030589 | S9AK450170 | SFP+-10G-LPBK  |
| Xcvr 15        | REV 01 | 740-030589 | S9AK450166 | SFP+-10G-LPBK  |
| Xcvr 16        | REV 01 | 740-030589 | S9AK450092 | SFP+-10G-LPBK  |
| Xcvr 17        | REV 01 | 740-030589 | S9AK450163 | SFP+-10G-LPBK  |
| Xcvr 18        | REV 01 | 740-030589 | S9AK450094 | SFP+-10G-LPBK  |
| Xcvr 19        | REV 01 | 740-030589 | S9AK450100 | SFP+-10G-LPBK  |
| Xcvr 20        | REV 01 | 740-030589 | S9AK450168 | SFP+-10G-LPBK  |
| Xcvr 21        | REV 01 | 740-030589 | S9AK450165 | SFP+-10G-LPBK  |
| Xcvr 22        | REV 01 | 740-030589 | S9AK450073 | SFP+-10G-LPBK  |
| Xcvr 23        | REV 01 | 740-030589 | S9AK450164 | SFP+-10G-LPBK  |
| Xcvr 24        | REV 01 | 740-030589 | S9AK450074 | SFP+-10G-LPBK  |
| Xcvr 25        | REV 01 | 740-030589 | SA62270195 | SFP+-10G-LPBK  |
| Xcvr 26        | REV 01 | 740-030589 | S9AK450078 | SFP+-10G-LPBK  |
| Xcvr 27        | REV 01 | 740-030589 | S9AK450024 | SFP+-10G-LPBK  |
| Xcvr 28        | REV 01 | 740-030589 | S9AK450027 | SFP+-10G-LPBK  |
| Xcvr 29        | REV 01 | 740-030589 | S9AK450080 | SFP+-10G-LPBK  |
| Xcvr 30        | REV 01 | 740-030589 | S9AK450030 | SFP+-10G-LPBK  |
| Xcvr 31        | REV 01 | 740-030589 | S9AK450025 | SFP+-10G-LPBK  |
| Xcvr 32        | REV 01 | 740-030589 | S9AK450023 | SFP+-10G-LPBK  |
| Xcvr 33        | REV 01 | 740-030589 | S9AK450075 | SFP+-10G-LPBK  |
| Xcvr 34        | REV 01 | 740-030589 | S9AK450161 | SFP+-10G-LPBK  |
| Xcvr 35        | REV 01 | 740-030589 | S9AK450071 | SFP+-10G-LPBK  |
| Xcvr 36        | REV 01 | 740-030589 | S9AK450072 | SFP+-10G-LPBK  |
| Xcvr 37        | REV 01 | 740-030589 | S9AK450022 | SFP+-10G-LPBK  |
| Xcvr 38        | REV 01 | 740-030589 | S9AK450021 | SFP+-10G-LPBK  |
| Xcvr 39        | REV 01 | 740-030589 | S9AK450175 | SFP+-10G-LPBK  |
| Xcvr 40        | REV 01 | 740-030589 | S9AK450162 | SFP+-10G-LPBK  |
| Xcvr 41        | REV 01 | 740-030589 | S99E270074 | SFP+-10G-LPBK  |
| Xcvr 42        | REV 01 | 740-030589 | S9AK450174 | SFP+-10G-LPBK  |
| Xcvr 43        | REV 01 | 740-030589 | S9AK450077 | SFP+-10G-LPBK  |
| Xcvr 44        | REV 01 | 740-030589 | S9AK450076 | SFP+-10G-LPBK  |
| Xcvr 45        | REV 01 | 740-030589 | S9AK450026 | SFP+-10G-LPBK  |
| Xcvr 46        | REV 01 | 740-030589 | S9AK450079 | SFP+-10G-LPBK  |
| Xcvr 47        | REV 01 | 740-030589 | S9AK450029 | SFP+-10G-LPBK  |
| PIC 1          |        | BUILTIN    | BUILTIN    | 15x 10G-SFP+   |
| Xcvr 1         | REV 01 | 740-032986 | QA170087   | QSFP+-40G-SR4  |
| Xcvr 4         | REV 01 | 740-032986 | QA360442   | QSFP+-40G-SR4  |
| Xcvr 8         | REV 01 | 740-032986 | QA170091   | QSFP+-40G-SR4  |
| Xcvr 12        | REV 01 | 740-032986 | QA170042   | QSFP+-40G-SR4  |
| MGMT BRD       | REV 08 | 750-036946 | EE0731     | QFX3500-MB     |
| Power Supply 0 | Rev 04 | 740-032091 | UI00690    | QFX PS 650W AC |
| Power Supply 1 | Rev 04 | 740-032091 | UI00679    | QFX PS 650W AC |
| Fan Tray 0     |        |            |            | QFX Fan Tray   |
| Fan Tray 1     |        |            |            | QFX Fan Tray   |

**show chassis hardware models (QFX3500 Switches)**

```

user@switch> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
Routing Engine 0      BUILTIN  BUILTIN
FPC 0          REV 02   711-032234  EC4074
Power Supply 0  PSMI 2C  11-d65800  --

```

**show chassis hardware clei-models (QFX3500 Switches)**

```

user@switch> show chassis hardware clei-models
Hardware inventory:
Item          Version  Part number  CLEI code      FRU model number
Routing Engine 0      BUILTIN
FPC 0          REV 02   711-032234
Power Supply 0  PSMI 2C  11-d65800

```

**show chassis hardware clei-models (QFX5100 Switches)**

```

user@switch> show chassis hardware clei-models
Hardware inventory:
Item          Version  Part number  CLEI code      FRU model number
Routing Engine 0      BUILTIN  CMMNV10BRA
FPC 0          REV 01   611-053010  CMMNV10BRA
PIC 0          BUILTIN  CMMNV10BRA
Power Supply 0  REV 03   740-053352  MUPABHBAA      JPSU-850W-AC-AFO
Power Supply 1  REV 03   740-053352  MUPABHBAA      JPSU-850W-AC-AFO
Fan Tray 0
Fan Tray 1      QFX5100-96S-FANAFO
Fan Tray 2      QFX5100-96S-FANAFO

```

**show chassis hardware interconnect-device (QFabric Systems)**

```

user@switch> show chassis hardware interconnect-device interconnect1
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis       REV 07
Midplane      REV 07   750-021261  BH0208188289  QFX Midplane
CB 0          REV 07   750-021261  BH0208188289  QFXIC08-CB4S

```

**show chassis hardware node-device (QFabric Systems)**

```

user@switch> show chassis hardware node-device node1
Routing Engine 0  BUILTIN  BUILTIN  QFX Routing Engine
node1            REV 05   711-032234  ED3694      QFX3500-48S4Q-AFI

CPU              BUILTIN  BUILTIN  FPC CPU
PIC 0            BUILTIN  BUILTIN  48x 10G-SFP+
Xcvr 8          REV 01   740-030658  AD0946A028B  SFP+-10G-USR
...

```

**show chassis hardware (PTX5000 Packet Transport Router)**

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis
Midplane      REV 03   711-031896  ABAC5589      Midplane-8S
FPM           REV 08   760-030647  EG1679        Front Panel Display

```



|                  |        |            |              |                     |
|------------------|--------|------------|--------------|---------------------|
| PDU 0            | Rev 05 | 740-032019 | ZE00006      | DC Power Dist Unit  |
| PSM 0            | Rev 05 | 740-032022 | ZJ00018      | DC 12V Power Supply |
| PSM 1            | Rev 04 | 740-032022 | ZC00052      | DC 12V Power Supply |
| PSM 2            | Rev 04 | 740-032022 | ZD00051      | DC 12V Power Supply |
| PSM 3            | Rev 05 | 740-032022 | ZJ00060      | DC 12V Power Supply |
| CCG 0            | REV 04 | 750-030653 | EG3703       | Clock Generator     |
| CCG 1            | REV 04 | 750-030653 | EG3698       | Clock Generator     |
| Routing Engine 0 | REV 05 | 740-026942 | P737A-002231 | RE-DUO-2600         |
| Routing Engine 1 | REV 06 | 740-026942 | P737A-002438 | RE-DUO-2600         |
| CB 0             | REV 08 | 750-030625 | EG5519       | Control Board       |
| CB 1             | REV 08 | 750-030625 | EG5516       | Control Board       |
| FPC 0            | REV 18 | 750-036844 | EJ3080       | FPC                 |
| CPU              | REV 12 | 711-030686 | EJ3260       | SNG PMB             |
| FPC 2            | REV 13 | 750-036844 | EG5065       | FPC                 |
| CPU              | REV 09 | 711-030686 | EG4082       | SNG PMB             |
| PIC 0            | REV 14 | 750-031913 | EG5127       | 24x 10GE(LAN) SFP+  |
| Xcvr 0           | REV 01 | 740-031980 | 143363A00240 | SFP+-10G-SR         |
| Xcvr 1           | REV 01 | 740-031981 | UK90PZ1      | SFP+-10G-LR         |
| Xcvr 2           | REV 01 | 740-031980 | AD1141A04XH  | SFP+-10G-SR         |
| Xcvr 3           | REV 01 | 740-031981 | UK90Q46      | SFP+-10G-LR         |
| Xcvr 4           | REV 01 | 740-031980 | AD1141A04X4  | SFP+-10G-SR         |
| Xcvr 6           | REV 01 | 740-031980 | B11H02560    | SFP+-10G-SR         |
| Xcvr 7           | REV 01 | 740-031980 | B11C01589    | SFP+-10G-SR         |
| Xcvr 8           | REV 01 | 740-031980 | AD1141A04XF  | SFP+-10G-SR         |
| Xcvr 10          | REV 01 | 740-031980 | 123363A01094 | SFP+-10G-SR         |
| Xcvr 11          | REV 01 | 740-031980 | AK80LKF      | SFP+-10G-SR         |
| Xcvr 12          | REV 01 | 740-031980 | 183363A01528 | SFP+-10G-SR         |
| Xcvr 14          | REV 01 | 740-031980 | 193363A01079 | SFP+-10G-SR         |
| Xcvr 15          | REV 01 | 740-031980 | AK80MC8      | SFP+-10G-SR         |
| Xcvr 16          | REV 01 | 740-031980 | AJCOBHC      | SFP+-10G-SR         |
| Xcvr 19          | REV 01 | 740-021309 | J08D26856    | SFP+-10G-LR         |
| Xcvr 21          | REV 01 | 740-031980 | AK80KCT      | SFP+-10G-SR         |
| Xcvr 22          | REV 01 | 740-031981 | UK90PZL      | SFP+-10G-LR         |
| Xcvr 23          | REV 01 | 740-031980 | AK80N1V      | SFP+-10G-SR         |
| FPC 3            | REV 13 | 750-036844 | EG5074       | FPC                 |
| CPU              | REV 09 | 711-030686 | EG4064       | SNG PMB             |
| PIC 1            | REV 10 | 750-031903 | EG0325       | SNG Load            |
| FPC 5            | REV 06 | 750-036844 | EH3198       | FPC                 |
| CPU              |        |            |              |                     |
| PIC 0            | REV 14 | 750-031913 | EG5134       | 24x 10GE(LAN) SFP+  |
| Xcvr 0           | REV 01 | 740-031980 | AK80LBH      | SFP+-10G-SR         |
| Xcvr 1           | REV 01 | 740-031980 | B11B03724    | SFP+-10G-SR         |
| Xcvr 2           | REV 01 | 740-031980 | AK80FMH      | SFP+-10G-SR         |
| Xcvr 5           | REV 01 | 740-031980 | B11J00818    | SFP+-10G-SR         |
| Xcvr 6           | REV 01 | 740-031980 | 193363A00743 | SFP+-10G-SR         |
| Xcvr 7           | REV 01 | 740-031980 | B11B06125    | SFP+-10G-SR         |
| Xcvr 10          | REV 01 | 740-031980 | B11H02529    | SFP+-10G-SR         |
| Xcvr 11          | REV 01 | 740-031980 | AK80LFB      | SFP+-10G-SR         |
| Xcvr 12          | REV 01 | 740-031980 | 193363A01061 | SFP+-10G-SR         |
| Xcvr 15          | REV 01 | 740-031980 | B11J00687    | SFP+-10G-SR         |
| Xcvr 16          | REV 01 | 740-031980 | 193363A00738 | SFP+-10G-SR         |
| Xcvr 18          | REV 01 | 740-031980 | AK80MQX      | SFP+-10G-SR         |
| Xcvr 19          | REV 01 | 740-021309 | J08C17257    | SFP+-10G-LR         |
| Xcvr 22          | REV 01 | 740-031980 | B11J00730    | SFP+-10G-SR         |
| Xcvr 23          | REV 01 | 740-031980 | AK80KEE      | SFP+-10G-SR         |
| PIC 1            | REV 08 | 750-036710 | EG3105       | 2x 40GE CFP         |
| Xcvr 0           | REV 01 | 740-034554 | B260HLT      | CFP-40G-LR4         |
| Xcvr 1           | REV 01 | 740-034554 | B11C02847    | CFP-40G-LR4         |
| FPC 6            | REV 18 | 750-036844 | EJ4391       | FPC                 |
| CPU              | REV 12 | 711-030686 | EJ3257       | SNG PMB             |
| FPC 7            | REV 18 | 750-036844 | EJ4382       | FPC                 |

|            |        |            |        |                     |
|------------|--------|------------|--------|---------------------|
| CPU        | REV 12 | 711-030686 | EJ3238 | SNG PMB             |
| SPMB 0     | REV 10 | 711-030686 | EG5418 | SNG PMB             |
| SPMB 1     | REV 09 | 711-030686 | EG5373 | SNG PMB             |
| SIB 0      | REV 07 | 750-030631 | EG4858 | SIB-I-8S            |
| SIB 1      | REV 07 | 750-030631 | EG4872 | SIB-I-8S            |
| SIB 2      | REV 07 | 750-030631 | EG4866 | SIB-I-8S            |
| SIB 3      | REV 07 | 750-030631 | EG6011 | SIB-I-8S            |
| SIB 4      | REV 07 | 750-030631 | EG4907 | SIB-I-8S            |
| SIB 5      | REV 07 | 750-030631 | EG4879 | SIB-I-8S            |
| SIB 6      | REV 07 | 750-030631 | EG4864 | SIB-I-8S            |
| SIB 7      | REV 07 | 750-030631 | EG4899 | SIB-I-8S            |
| SIB 8      | REV 07 | 750-030631 | EG4880 | SIB-I-8S            |
| Fan Tray 0 | REV 04 | 760-032784 | EG1496 | Vertical Fan Tray   |
| Fan Tray 1 | REV 04 | 760-030642 | EG1335 | Horizontal Fan Tray |
| Fan Tray 2 | REV 02 | 760-030642 | ED4952 | Horizontal Fan Tray |

### show chassis hardware (PTX5000 Packet Transport Router with AC PSM and PDU)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN12223A6AJA  PTX5000
Midplane      REV 16   750-035893   ACRA1350       Midplane-8S
FPM           REV 12   760-030647   BBBD5625       Front Panel Display
PDU 0         Rev 01   740-048338   1GB83360005    High Capacity AC WYE PDU

    PSM 0         Rev 01   740-048334   1GB43360074    High Capacity AC PSM
    PSM 1         Rev 01   740-048334   1GB43360001    High Capacity AC PSM
    PSM 2         Rev 01   740-048334   1GB43360104    High Capacity AC PSM
    PSM 3         Rev 01   740-048334   1GB43360042    High Capacity AC PSM
    PSM 4         Rev 01   740-048334   1GB43360068    High Capacity AC PSM
    PSM 5         Rev 01   740-048334   1GB43360080    High Capacity AC PSM
    PSM 6         Rev 01   740-048334   1GB43360046    High Capacity AC PSM
    PSM 7         Rev 01   740-048334   1GB43360100    High Capacity AC PSM
PDU 1         Rev 01   740-048338   1GB83360006    High Capacity AC WYE PDU

    PSM 0         Rev 01   740-048334   1GB43360069    High Capacity AC PSM
    PSM 1         Rev 01   740-048334   1GB43360099    High Capacity AC PSM
    PSM 2         Rev 01   740-048334   1GB43360050    High Capacity AC PSM
    PSM 3         Rev 01   740-048334   1GB43360095    High Capacity AC PSM
    PSM 4         Rev 01   740-048334   1GB43360101    High Capacity AC PSM
    PSM 5         Rev 01   740-048334   1GB43360075    High Capacity AC PSM
    PSM 6         Rev 01   740-048334   1GB43360047    High Capacity AC PSM
    PSM 7         Rev 01   740-048334   1GB43360019    High Capacity AC PSM
CCG 0         REV 09   750-030653   BBAZ5345       Clock Generator
...

```

### show chassis hardware (PTX5000 Packet Transport Router with FPC2-PTX-PIA)

```

user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN1204FC0AJA  PTX5000
Midplane      REV 11   750-035893   ACAB8038       Midplane-8S
FPM           REV 12   760-030647   BBBD5619       Front Panel
Display
PDU 0         Rev 04   740-048336   1GB93470043    High Capacity DC PDU
    PSM 0         Rev 04   740-046988   1GB63500184    High Capacity DC PSM
    PSM 2         Rev 04   740-046988   1GB63500169    High Capacity DC PSM
    PSM 4         Rev 04   740-046988   1GB63500306    High Capacity DC PSM
    PSM 6         Rev 04   740-046988   1GB63500074    High Capacity DC PSM

```

|       |        |            |             |                      |
|-------|--------|------------|-------------|----------------------|
| PDU 1 | Rev 04 | 740-048336 | 1GB93470045 | High Capacity DC PDU |
| PSM 1 | Rev 04 | 740-046988 | 1GB63500193 | High Capacity DC PSM |
| PSM 3 | Rev 04 | 740-046988 | 1GB63500143 | High Capacity DC PSM |
| PSM 5 | Rev 04 | 740-046988 | 1GB63500146 | High Capacity DC PSM |
| PSM 7 | Rev 04 | 740-046988 | 1GB63500192 | High Capacity DC PSM |
| CCG 0 | REV 09 | 750-030653 | BBBC1909    | Clock Generator      |
| CCG 1 | REV 09 | 750-030653 | BBBD2970    | Clock Generator      |
| ...   |        |            |             |                      |

### show chassis hardware clei-models (PTX5000 Packet Transport Router)

```
user@host> show chassis hardware clei-models
Hardware inventory:
```

| Item             | Version | Part number | CLEI code  | FRU model number    |
|------------------|---------|-------------|------------|---------------------|
| FPM              | REV 08  | 760-030647  | PROTOXCLEI | CRAFT-PTX5000-S     |
| PDU 0            | Rev 05  | 740-032019  | IPUPAHLKAA | PWR-SAN-PDU-DC      |
| PSM 0            | Rev 05  | 740-032022  | IPUPAHNKAA | PSM-PTX-DC-120-S    |
| PSM 1            | Rev 04  | 740-032022  | 032022XXXX | PWR-SAN-12-DC       |
| PSM 2            | Rev 04  | 740-032022  | 032022XXXX | PWR-SAN-12-DC       |
| PSM 3            | Rev 05  | 740-032022  | IPUPAHNKAA | PSM-PTX-DC-120-S    |
| CCG 0            | REV 04  | 750-030653  | PROTOXCLEI | CCG-PTX-S           |
| CCG 1            | REV 04  | 750-030653  | PROTOXCLEI | CCG-PTX-S           |
| Routing Engine 0 | REV 05  | 740-026942  |            | RE-DUO-C2600-16G-S  |
| Routing Engine 1 | REV 06  | 740-026942  |            | RE-DUO-C2600-16G-S  |
| CB 0             | REV 08  | 750-030625  | PROTOXCLEI | CB-PTX-S            |
| CB 1             | REV 08  | 750-030625  | PROTOXCLEI | CB-PTX-S            |
| FPC 0            | REV 18  | 750-036844  | PROTOXCLEI | FPC-PTX-P1-A        |
| FPC 2            | REV 13  | 750-036844  | PROTOXCLEI | FPC-PTX-P1-A        |
| PIC 0            | REV 14  | 750-031913  | PROTOXCLEI | P1-PTX-24-10GE-SFPP |
| FPC 3            | REV 13  | 750-036844  | PROTOXCLEI | FPC-PTX-P1-A        |
| FPC 5            |         |             |            |                     |
| PIC 0            | REV 14  | 750-031913  | PROTOXCLEI | P1-PTX-24-10GE-SFPP |
| FPC 6            | REV 18  | 750-036844  | PROTOXCLEI | FPC-PTX-P1-A        |
| FPC 7            | REV 18  | 750-036844  | PROTOXCLEI | FPC-PTX-P1-A        |
| SIB 0            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 1            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 2            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 3            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 4            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 5            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 6            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 7            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| SIB 8            | REV 07  | 750-030631  | PROTOXCLEI | SIB-I-PTX5008       |
| Fan Tray 1       | REV 04  | 760-030642  | PROTOXCLEI | FAN-PTX-H-S         |

### show chassis hardware clei-models (PTX5000 Packet Transport Router with AC PSM and PDU)

```
user@host> show chassis hardware clei-models
Hardware inventory:
```

| Item     | Version | Part number | CLEI code  | FRU model number  |
|----------|---------|-------------|------------|-------------------|
| Midplane | REV 16  | 750-035893  | IPMUN00ARA | CHAS-MP-PTX5000-S |
| FPM      | REV 12  | 760-030647  | IPUCA7SCAA | CRAFT-PTX5000-S   |
| PDU 0    | Rev 01  | 740-048338  | PROTOACPDU | PDU2-PTX-AC-W     |
| PSM 0    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 1    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 2    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 3    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 4    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 5    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 6    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |
| PSM 7    | Rev 01  | 740-048334  | PROTOACPSM | PSM2-PTX-AC       |

|       |        |            |            |               |
|-------|--------|------------|------------|---------------|
| PDU 1 | Rev 01 | 740-048338 | PROTOACPDU | PDU2-PTX-AC-W |
| PSM 0 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 1 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 2 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 3 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 4 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 5 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 6 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| PSM 7 | Rev 01 | 740-048334 | PROTOACPSM | PSM2-PTX-AC   |
| CCG 0 | REV 09 | 750-030653 | IPUCA7DCAA | CCG-PTX-S     |
| ...   |        |            |            |               |

### show chassis hardware clei-models (PTX5000 Packet Transport Router with FPC2-PTX-P1A)

```

user@host> show chassis hardware clei-models
Hardware inventory:

```

| Item     | Version | Part number | CLEI code  | FRU model number  |
|----------|---------|-------------|------------|-------------------|
| Midplane | REV 11  | 750-035893  | IPMUN00ARA | CHAS-MP-PTX5000-S |
| FPM      | REV 12  | 760-030647  | IPUCA7SCAA | CRAFT-PTX5000-S   |
| PDU 0    | Rev 04  | 740-048336  | IPUPAL7KAA | PDU2-PTX-DC-S     |
| PSM 0    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 2    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 4    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 6    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PDU 1    | Rev 04  | 740-048336  | IPUPAL7KAA | PDU2-PTX-DC-S     |
| PSM 1    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 3    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 5    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| PSM 7    | Rev 04  | 740-046988  | IPUPAL8KAA | PSM2-PTX-DC-S     |
| CCG 0    | REV 09  | 750-030653  | IPUCA7DCAA | CCG-PTX-S         |
| CCG 1    | REV 09  | 750-030653  | IPUCA7DCAA | CCG-PTX-S         |
| ...      |         |             |            |                   |

### show chassis hardware detail (PTX5000 Packet Transport Router)

```

user@host> show chassis hardware detail
Hardware inventory:

```

| Item             | Version  | Part number           | Serial number        | Description         |
|------------------|----------|-----------------------|----------------------|---------------------|
| Chassis          |          |                       | JN11D1FD7AJA         | PTX5000             |
| Midplane         | REV 03   | 711-031896            | ABAC5589             | Midplane-8S         |
| FPM              | REV 08   | 760-030647            | EG1679               | Front Panel Display |
| PDU 0            | Rev 05   | 740-032019            | ZE00006              | DC Power Dist Unit  |
| PSM 0            | Rev 05   | 740-032022            | ZJ00018              | DC 12V Power Supply |
| PSM 1            | Rev 04   | 740-032022            | ZC00052              | DC 12V Power Supply |
| PSM 2            | Rev 04   | 740-032022            | ZD00051              | DC 12V Power Supply |
| PSM 3            | Rev 05   | 740-032022            | ZJ00060              | DC 12V Power Supply |
| CCG 0            | REV 04   | 750-030653            | EG3703               | Clock Generator     |
| CCG 1            | REV 04   | 750-030653            | EG3698               | Clock Generator     |
| Routing Engine 0 | REV 05   | 740-026942            | P737A-002231         | RE-DUO-2600         |
| ad0              | 3823 MB  | SMART CF              | 201006190039C02DC02D | Compact Flash       |
| ad1              | 62720 MB | SMART Lite SATA Drive | 2011042300CF4C6B4C6B | Disk 1              |
| Routing Engine 1 | REV 06   | 740-026942            | P737A-002438         | RE-DUO-2600         |
| ad0              | 3823 MB  | SMART CF              | 20100619053455F055F0 | Compact Flash       |
| ad1              | 62720 MB | SMART Lite SATA Drive | 20110423000AE8E7E8E7 | Disk 1              |
| CB 0             | REV 08   | 750-030625            | EG5519               | Control Board       |
| CB 1             | REV 08   | 750-030625            | EG5516               | Control Board       |
| FPC 0            | REV 18   | 750-036844            | EJ3080               | FPC                 |
| CPU              | REV 12   | 711-030686            | EJ3260               | SNG PMB             |
| FPC 2            | REV 13   | 750-036844            | EG5065               | FPC                 |
| CPU              | REV 09   | 711-030686            | EG4082               | SNG PMB             |
| PIC 0            | REV 14   | 750-031913            | EG5127               | 24x 10GE(LAN) SFP+  |

|            |        |            |              |                     |
|------------|--------|------------|--------------|---------------------|
| Xcvr 0     | REV 01 | 740-031980 | 143363A00240 | SFP+-10G-SR         |
| Xcvr 1     | REV 01 | 740-031981 | UK90PZ1      | SFP+-10G-LR         |
| Xcvr 2     | REV 01 | 740-031980 | AD1141A04XH  | SFP+-10G-SR         |
| Xcvr 3     | REV 01 | 740-031981 | UK90Q46      | SFP+-10G-LR         |
| Xcvr 4     | REV 01 | 740-031980 | AD1141A04X4  | SFP+-10G-SR         |
| Xcvr 6     | REV 01 | 740-031980 | B11H02560    | SFP+-10G-SR         |
| Xcvr 7     | REV 01 | 740-031980 | B11C01589    | SFP+-10G-SR         |
| Xcvr 8     | REV 01 | 740-031980 | AD1141A04XF  | SFP+-10G-SR         |
| Xcvr 10    | REV 01 | 740-031980 | 123363A01094 | SFP+-10G-SR         |
| Xcvr 11    | REV 01 | 740-031980 | AK80LKF      | SFP+-10G-SR         |
| Xcvr 12    | REV 01 | 740-031980 | 183363A01528 | SFP+-10G-SR         |
| Xcvr 14    | REV 01 | 740-031980 | 193363A01079 | SFP+-10G-SR         |
| Xcvr 15    | REV 01 | 740-031980 | AK80MC8      | SFP+-10G-SR         |
| Xcvr 16    | REV 01 | 740-031980 | AJC0BHC      | SFP+-10G-SR         |
| Xcvr 19    | REV 01 | 740-021309 | J08D26856    | SFP+-10G-LR         |
| Xcvr 21    | REV 01 | 740-031980 | AK80KCT      | SFP+-10G-SR         |
| Xcvr 22    | REV 01 | 740-031981 | UK90PZL      | SFP+-10G-LR         |
| Xcvr 23    | REV 01 | 740-031980 | AK80N1V      | SFP+-10G-SR         |
| FPC 3      | REV 13 | 750-036844 | EG5074       | FPC                 |
| CPU        | REV 09 | 711-030686 | EG4064       | SNG PMB             |
| PIC 1      | REV 10 | 750-031903 | EG0325       | SNG Load            |
| FPC 5      | REV 06 | 750-036844 | EH3198       | FPC                 |
| CPU        |        |            |              |                     |
| PIC 0      | REV 14 | 750-031913 | EG5134       | 24x 10GE(LAN) SFP+  |
| Xcvr 0     | REV 01 | 740-031980 | AK80LBH      | SFP+-10G-SR         |
| Xcvr 1     | REV 01 | 740-031980 | B11B03724    | SFP+-10G-SR         |
| Xcvr 2     | REV 01 | 740-031980 | AK80FMH      | SFP+-10G-SR         |
| Xcvr 5     | REV 01 | 740-031980 | B11J00818    | SFP+-10G-SR         |
| Xcvr 6     | REV 01 | 740-031980 | 193363A00743 | SFP+-10G-SR         |
| Xcvr 7     | REV 01 | 740-031980 | B11B06125    | SFP+-10G-SR         |
| Xcvr 10    | REV 01 | 740-031980 | B11H02529    | SFP+-10G-SR         |
| Xcvr 11    | REV 01 | 740-031980 | AK80LFB      | SFP+-10G-SR         |
| Xcvr 12    | REV 01 | 740-031980 | 193363A01061 | SFP+-10G-SR         |
| Xcvr 15    | REV 01 | 740-031980 | B11J00687    | SFP+-10G-SR         |
| Xcvr 16    | REV 01 | 740-031980 | 193363A00738 | SFP+-10G-SR         |
| Xcvr 18    | REV 01 | 740-031980 | AK80MQX      | SFP+-10G-SR         |
| Xcvr 19    | REV 01 | 740-021309 | J08C17257    | SFP+-10G-LR         |
| Xcvr 22    | REV 01 | 740-031980 | B11J00730    | SFP+-10G-SR         |
| Xcvr 23    | REV 01 | 740-031980 | AK80KEE      | SFP+-10G-SR         |
| PIC 1      | REV 08 | 750-036710 | EG3105       | 2x 40GE CFP         |
| Xcvr 0     | REV 01 | 740-034554 | B260HLT      | CFP-40G-LR4         |
| Xcvr 1     | REV 01 | 740-034554 | B11C02847    | CFP-40G-LR4         |
| FPC 6      | REV 18 | 750-036844 | EJ4391       | FPC                 |
| CPU        | REV 12 | 711-030686 | EJ3257       | SNG PMB             |
| FPC 7      | REV 18 | 750-036844 | EJ4382       | FPC                 |
| CPU        | REV 12 | 711-030686 | EJ3238       | SNG PMB             |
| SPMB 0     | REV 10 | 711-030686 | EG5418       | SNG PMB             |
| SPMB 1     | REV 09 | 711-030686 | EG5373       | SNG PMB             |
| SIB 0      | REV 07 | 750-030631 | EG4858       | SIB-I-8S            |
| SIB 1      | REV 07 | 750-030631 | EG4872       | SIB-I-8S            |
| SIB 2      | REV 07 | 750-030631 | EG4866       | SIB-I-8S            |
| SIB 3      | REV 07 | 750-030631 | EG6011       | SIB-I-8S            |
| SIB 4      | REV 07 | 750-030631 | EG4907       | SIB-I-8S            |
| SIB 5      | REV 07 | 750-030631 | EG4879       | SIB-I-8S            |
| SIB 6      | REV 07 | 750-030631 | EG4864       | SIB-I-8S            |
| SIB 7      | REV 07 | 750-030631 | EG4899       | SIB-I-8S            |
| SIB 8      | REV 07 | 750-030631 | EG4880       | SIB-I-8S            |
| Fan Tray 0 | REV 04 | 760-032784 | EG1496       | Vertical Fan Tray   |
| Fan Tray 1 | REV 04 | 760-030642 | EG1335       | Horizontal Fan Tray |
| Fan Tray 2 | REV 02 | 760-030642 | ED4952       | Horizontal Fan Tray |

## show chassis hardware detail (PTX5000 Packet Transport Router with AC PSM and PDU)

```

user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN12223A6AJA  PTX5000
Midplane      REV 16   750-035893  ACRA1350       Midplane-8S
FPM           REV 12   760-030647  BBBD5625       Front Panel Display
PDU 0         Rev 01   740-048338  1GB83360005    High Capacity AC WYE PDU

    PSM 0      Rev 01   740-048334  1GB43360074    High Capacity AC PSM
    PSM 1      Rev 01   740-048334  1GB43360001    High Capacity AC PSM
    PSM 2      Rev 01   740-048334  1GB43360104    High Capacity AC PSM
    PSM 3      Rev 01   740-048334  1GB43360042    High Capacity AC PSM
    PSM 4      Rev 01   740-048334  1GB43360068    High Capacity AC PSM
    PSM 5      Rev 01   740-048334  1GB43360080    High Capacity AC PSM
    PSM 6      Rev 01   740-048334  1GB43360046    High Capacity AC PSM
    PSM 7      Rev 01   740-048334  1GB43360100    High Capacity AC PSM
PDU 1         Rev 01   740-048338  1GB83360006    High Capacity AC WYE PDU

    PSM 0      Rev 01   740-048334  1GB43360069    High Capacity AC PSM
    PSM 1      Rev 01   740-048334  1GB43360099    High Capacity AC PSM
    PSM 2      Rev 01   740-048334  1GB43360050    High Capacity AC PSM
    PSM 3      Rev 01   740-048334  1GB43360095    High Capacity AC PSM
    PSM 4      Rev 01   740-048334  1GB43360101    High Capacity AC PSM
    PSM 5      Rev 01   740-048334  1GB43360075    High Capacity AC PSM
    PSM 6      Rev 01   740-048334  1GB43360047    High Capacity AC PSM
    PSM 7      Rev 01   740-048334  1GB43360019    High Capacity AC PSM
CCG 0         REV 09   750-030653  BBAZ5345       Clock Generator

```

## show chassis hardware detail (PTX5000 Packet Transport Router with FPC2-PTX-P1A)

```

user@host> show chassis hardware detail
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN1204FC0AJA  PTX5000
Midplane      REV 11   750-035893  ACAB8038       Midplane-8S
FPM           REV 12   760-030647  BBBD5619       Front Panel
Display
PDU 0         Rev 04   740-048336  1GB93470043    High Capacity DC PDU
    PSM 0      Rev 04   740-046988  1GB63500184    High Capacity DC PSM
    PSM 2      Rev 04   740-046988  1GB63500169    High Capacity DC PSM
    PSM 4      Rev 04   740-046988  1GB63500306    High Capacity DC PSM
    PSM 6      Rev 04   740-046988  1GB63500074    High Capacity DC PSM
PDU 1         Rev 04   740-048336  1GB93470045    High Capacity DC PDU
    PSM 1      Rev 04   740-046988  1GB63500193    High Capacity DC PSM
    PSM 3      Rev 04   740-046988  1GB63500143    High Capacity DC PSM
    PSM 5      Rev 04   740-046988  1GB63500146    High Capacity DC PSM
    PSM 7      Rev 04   740-046988  1GB63500192    High Capacity DC PSM
CCG 0         REV 09   750-030653  BBBC1909       Clock Generator
CCG 1         REV 09   750-030653  BBBD2970       Clock Generator
...

```

## show chassis hardware models (PTX5000 Packet Transport Router)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
FPM           REV 08   760-030647  EG1679         CRAFT-PTX5000-S
PDU 0         Rev 05   740-032019  ZE00006        PWR-SAN-PDU-DC
    PSM 0      Rev 05   740-032022  ZJ00018        PSM-PTX-DC-120-S

```

|                  |        |            |              |                     |
|------------------|--------|------------|--------------|---------------------|
| PSM 1            | Rev 04 | 740-032022 | ZC00052      | PWR-SAN-12-DC       |
| PSM 2            | Rev 04 | 740-032022 | ZD00051      | PWR-SAN-12-DC       |
| PSM 3            | Rev 05 | 740-032022 | ZJ00060      | PSM-PTX-DC-120-S    |
| CCG 0            | REV 04 | 750-030653 | EG3703       | CCG-PTX-S           |
| CCG 1            | REV 04 | 750-030653 | EG3698       | CCG-PTX-S           |
| Routing Engine 0 | REV 05 | 740-026942 | P737A-002231 | RE-DUO-C2600-16G-S  |
| Routing Engine 1 | REV 06 | 740-026942 | P737A-002438 | RE-DUO-C2600-16G-S  |
| CB 0             | REV 08 | 750-030625 | EG5519       | CB-PTX-S            |
| CB 1             | REV 08 | 750-030625 | EG5516       | CB-PTX-S            |
| FPC 0            | REV 18 | 750-036844 | EJ3080       | FPC-PTX-P1-A        |
| FPC 2            | REV 13 | 750-036844 | EG5065       | FPC-PTX-P1-A        |
| PIC 0            | REV 14 | 750-031913 | EG5127       | P1-PTX-24-10GE-SFPP |
| FPC 3            | REV 13 | 750-036844 | EG5074       | FPC-PTX-P1-A        |
| FPC 5            |        |            |              |                     |
| PIC 0            | REV 14 | 750-031913 | EG5134       | P1-PTX-24-10GE-SFPP |
| FPC 6            | REV 18 | 750-036844 | EJ4391       | FPC-PTX-P1-A        |
| FPC 7            | REV 18 | 750-036844 | EJ4382       | FPC-PTX-P1-A        |
| SIB 0            | REV 07 | 750-030631 | EG4858       | SIB-I-PTX5008       |
| SIB 1            | REV 07 | 750-030631 | EG4872       | SIB-I-PTX5008       |
| SIB 2            | REV 07 | 750-030631 | EG4866       | SIB-I-PTX5008       |
| SIB 3            | REV 07 | 750-030631 | EG6011       | SIB-I-PTX5008       |
| SIB 4            | REV 07 | 750-030631 | EG4907       | SIB-I-PTX5008       |
| SIB 5            | REV 07 | 750-030631 | EG4879       | SIB-I-PTX5008       |
| SIB 6            | REV 07 | 750-030631 | EG4864       | SIB-I-PTX5008       |
| SIB 7            | REV 07 | 750-030631 | EG4899       | SIB-I-PTX5008       |
| SIB 8            | REV 07 | 750-030631 | EG4880       | SIB-I-PTX5008       |
| Fan Tray 1       | REV 04 | 760-030642 | EG1335       | FAN-PTX-H-S         |

#### show chassis hardware models (PTX5000 Packet Transport Router with AC PSM and PDU)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number
Midplane      REV 16   750-035893   ACRA1350      CHAS-MP-PTX5000-S
FPM           REV 12   760-030647   BBBD5625     CRAFT-PTX5000-S
PDU 0         Rev 01   740-048338   1GB83360005  PDU2-PTX-AC-W
  PSM 0       Rev 01   740-048334   1GB43360074  PSM2-PTX-AC
  PSM 1       Rev 01   740-048334   1GB43360001  PSM2-PTX-AC
  PSM 2       Rev 01   740-048334   1GB43360104  PSM2-PTX-AC
  PSM 3       Rev 01   740-048334   1GB43360042  PSM2-PTX-AC
  PSM 4       Rev 01   740-048334   1GB43360068  PSM2-PTX-AC
  PSM 5       Rev 01   740-048334   1GB43360080  PSM2-PTX-AC
  PSM 6       Rev 01   740-048334   1GB43360046  PSM2-PTX-AC
  PSM 7       Rev 01   740-048334   1GB43360100  PSM2-PTX-AC
PDU 1         Rev 01   740-048338   1GB83360006  PDU2-PTX-AC-W
  PSM 0       Rev 01   740-048334   1GB43360069  PSM2-PTX-AC
  PSM 1       Rev 01   740-048334   1GB43360099  PSM2-PTX-AC
  PSM 2       Rev 01   740-048334   1GB43360050  PSM2-PTX-AC
  PSM 3       Rev 01   740-048334   1GB43360095  PSM2-PTX-AC
  PSM 4       Rev 01   740-048334   1GB43360101  PSM2-PTX-AC
  PSM 5       Rev 01   740-048334   1GB43360075  PSM2-PTX-AC
  PSM 6       Rev 01   740-048334   1GB43360047  PSM2-PTX-AC
  PSM 7       Rev 01   740-048334   1GB43360019  PSM2-PTX-AC
CCG 0         REV 09   750-030653   BBAZ5345     CCG-PTX-S
...

```

#### show chassis hardware models (PTX5000 Packet Transport Router with FPC2-PTX-P1A)

```

user@host> show chassis hardware models
Hardware inventory:
Item          Version  Part number  Serial number  FRU model number

```

|          |        |            |             |                   |
|----------|--------|------------|-------------|-------------------|
| Midplane | REV 11 | 750-035893 | ACAB8038    | CHAS-MP-PTX5000-S |
| FPM      | REV 12 | 760-030647 | BBBD5619    | CRAFT-PTX5000-S   |
| PDU 0    | Rev 04 | 740-048336 | 1GB93470043 | PDU2-PTX-DC-S     |
| PSM 0    | Rev 04 | 740-046988 | 1GB63500184 | PSM2-PTX-DC-S     |
| PSM 2    | Rev 04 | 740-046988 | 1GB63500169 | PSM2-PTX-DC-S     |
| PSM 4    | Rev 04 | 740-046988 | 1GB63500306 | PSM2-PTX-DC-S     |
| PSM 6    | Rev 04 | 740-046988 | 1GB63500074 | PSM2-PTX-DC-S     |
| PDU 1    | Rev 04 | 740-048336 | 1GB93470045 | PDU2-PTX-DC-S     |
| PSM 1    | Rev 04 | 740-046988 | 1GB63500193 | PSM2-PTX-DC-S     |
| PSM 3    | Rev 04 | 740-046988 | 1GB63500143 | PSM2-PTX-DC-S     |
| PSM 5    | Rev 04 | 740-046988 | 1GB63500146 | PSM2-PTX-DC-S     |
| PSM 7    | Rev 04 | 740-046988 | 1GB63500192 | PSM2-PTX-DC-S     |
| CCG 0    | REV 09 | 750-030653 | BBBC1909    | CCG-PTX-S         |
| CCG 1    | REV 09 | 750-030653 | BBBD2970    | CCG-PTX-S         |
| ...      |        |            |             |                   |

### show chassis hardware extensive (PTX5000 Packet Transport Router)

```

user@host> show chassis hardware extensive
Hardware inventory:
Item              Version  Part number  Serial number  Description
.....
PDU 0             Rev 04   740-032019   UE0003         DC Power Dist Unit
Jedec Code:      0x7fb0          EEPROM Version: 0x02
P/N:             740-032019          S/N:           UE0003
Assembly ID:     0x043d          Assembly Version: 04.00
Date:           11-29-2010       Assembly Flags: 0x00
Version:        Rev 04          CLEI Code:     032022XXXX
ID: DC Power Dist Unit          FRU Model Number: PWR-SAN-PDU-DC
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 3d 04 00 52 65 76 20 30 34 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 32 30 31 39 00 00
Address 0x20: 53 2f 4e 20 55 45 30 30 30 33 00 00 00 1d 0b 07
Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 30 33 32 30 32 32 58 58 58 58 50
Address 0x50: 57 52 2d 53 41 4e 2d 50 44 55 2d 44 43 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 a3 ff ff ff ff ff ff ff ff ff ff ff ff
PSM 0             Rev 04   740-032022   YG00065        DC 12V Power Supply
Module
Jedec Code:      0x7fb0          EEPROM Version: 0x02
P/N:             740-032022          S/N:           YG00065
Assembly ID:     0x0440          Assembly Version: 04.00
Date:           07-30-2010       Assembly Flags: 0x00
Version:        Rev 04          CLEI Code:     032022XXXX
ID: DC 12V Power Supply Module  FRU Model Number: PWR-SAN-12-DC
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 04 40 04 00 52 65 76 20 30 34 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 33 32 30 32 32 00 00
Address 0x20: 53 2f 4e 20 59 47 30 30 30 36 35 00 00 1e 07 07
Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 30 33 32 30 32 32 58 58 58 58 50
Address 0x50: 57 52 2d 53 41 4e 2d 31 32 2d 44 43 20 20 20 20
Address 0x60: 20 20 20 20 20 20 01 00 ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff 0c ff ff ff ff ff ff ff ff ff ff ff ff

```



**show chassis hardware extensive (PTX1000 Packet Transport Router)**

```

user@host> show chassis hardware extensive
Hardware inventory:
Item              Version  Part number  Serial number  Description
Chassis                               UNDEFINED    PTX1000
Pseudo CB 0
Routing Engine 0
FPC 0              REV 06    750-053330   ACAM4850       PTX1000-FPC-P2-BUILTIN
CPU                BUILTIN   BUILTIN      FPC CPU
PIC 0              BUILTIN   BUILTIN      288X10GE/72X40GE/24X100GE

Xcvr 2             REV 01    740-046565   QE240845       QSFP+-40G-SR4
Xcvr 3             REV 01    740-046565   QE240962       QSFP+-40G-SR4
Xcvr 5             REV 01    740-032986   ES400LZ        QSFP+-40G-SR4
Xcvr 12            REV 01    740-054053   QE419452       QSFP+-4X10G-SR
Xcvr 18            REV 01    740-054053   QE419481       QSFP+-4X10G-SR
Xcvr 30            REV 01    740-046565   QE440485       QSFP+-40G-SR4
Xcvr 48            REV 01    740-032986   ES400K3        QSFP+-40G-SR4
Xcvr 68            REV 01    740-046565   QF2805J3       QSFP+-40G-SR4
Mezz               REV 05    711-053333   ACAM4282       Mezzanine Board
Power Supply 2     REV 01    740-054405   1EDN4470131    AC AFO 1600W PSU
Power Supply 3     REV 01    740-054405   1EDN4470112    AC AFO 1600W PSU
Fan Tray 0                                     PTX1000 Fan Tray 0, Front
to Back Airflow - AFO
Fan Tray 1                                     PTX1000 Fan Tray 1, Front
to Back Airflow - AFO
Fan Tray 2                                     PTX1000 Fan Tray 2, Front
to Back Airflow - AFO

```

**show chassis hardware (MX Routers with Media Services Blade [MSB])**

```

user@switch> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number  Description
Chassis                               JN1100FB1AFB  MX480
Midplane          REV 05    710-017414   TR3310         MX480 Midplane
FPM Board         REV 02    710-017254   KG1872         Front Panel Display
PEM 2             Rev 02    740-017343   QCS0812A00N    DC Power Entry Module
PEM 3             Rev 02    740-017343   QCS0812A00U    DC Power Entry Module
Routing Engine 0  REV 07    740-015113   1000740938     RE-S-1300
CB 0              REV 03    710-021523   KF4630         MX SCB
FPC 1             REV 11    750-037207   ZW9726         AS-MCC
CPU               REV 04    711-038173   ZW4819         AS-MCC PMB
MIC 0             REV 06    750-037214   ZW3574         AS-MSC
PIC 0             BUILTIN   BUILTIN      AS-MSC
MIC 1             REV 00    750-037211   BUILTIN        AS-MXC
PIC 2             BUILTIN   BUILTIN      AS-MXC

```

**show chassis hardware extensive (MX Routers with Media Services Blade [MSB])**

```

user@switch> show chassis hardware extensive
FPC 1              REV 11    750-037207   ZW9726         AS-MCC
Jedec Code:       0x7fb0          EEPROM Version: 0x02
P/N:              750-037207       S/N:           ZW9726
Assembly ID:      0x0b37          Assembly Version: 01.11
Date:             02-17-2012      Assembly Flags: 0x00
Version:          REV 11          CLEI Code:     PROTOXCLEI
ID: AS-MCC        FRU Model Number: 750-037207
Board Information Record:

```

```

Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 37 01 0b 52 45 56 20 31 31 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 30 37 00 00
Address 0x20: 53 2f 4e 20 5a 57 39 37 32 36 00 00 00 11 02 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
Address 0x50: 35 30 2d 30 33 37 32 30 37 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 31 31 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 5e ff ff ff ff ff ff ff ff ff ff ff ff
CPU          REV 04    711-038173    ZW4819          AS-MCC-PMB
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         711-038173      S/N:         ZW4819
Assembly ID: 0x0b38          Assembly Version: 01.04
Date:        12-30-2011      Assembly Flags: 0x00
Version:     REV 04
ID: AS-MCC PMB
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 38 01 04 52 45 56 20 30 34 00 00
Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 31 37 33 00 00
Address 0x20: 53 2f 4e 20 5a 57 34 38 31 39 00 00 00 1e 0c 07
Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 37
Address 0x50: 31 31 2d 30 33 38 31 37 33 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 30 34 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 60 00 00 00 00 00 00 00 00 00 00 00 00
MIC 0          REV 06    750-037214    ZW3574          AS-MS
Jedec Code:  0x7fb0          EEPROM Version:  0x02
P/N:         750-037214      S/N:         ZW3574
Assembly ID: 0x0a44          Assembly Version: 01.06
Date:        02-19-2012      Assembly Flags: 0x00
Version:     REV 06          CLEI Code:     PROTOXCLEI
ID: AS-MS          FRU Model Number: 750-037214
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0a 44 01 06 52 45 56 20 30 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 34 00 00
Address 0x20: 53 2f 4e 20 5a 57 33 35 37 34 00 00 00 13 02 07
Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
Address 0x50: 35 30 2d 30 33 37 32 31 34 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 30 36 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 60 c0 03 e5 f4 00 00 00 00 00 00 00 00
PIC 0          BUILTIN    BUILTIN          AS-MS
MIC 1          REV 00    750-037211          AS-MX
Jedec Code:  0x7fb0          EEPROM Version:  0x01
P/N:         750-037211
Assembly ID: 0x0a43          Assembly Version: 01.00
Date:        255-255-65535    Assembly Flags: 0x00
Version:     REV 00
ID: AS-MX
Board Information Record:
Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 01 ff 0a 43 01 00 52 45 56 20 30 30 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 31 00 00
Address 0x20: 00 00 00 00 00 00 00 00 00 00 00 00 00 ff ff ff
Address 0x30: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

```

```

Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff
Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff c0 02 e6 6c 7f b0 02 ff 0a 44 01 06
PIC 2                BUILTIN                BUILTIN                AS-MXC

```

### show chassis hardware (QFX3500 Switch running Enhanced Layer 2 Software)

```

user@switch> show chassis hardware
Hardware inventory:
Item                Version  Part number  Serial number  Description
Chassis
Pseudo CB 0
Routing Engine 0
FPC 0                REV 16      750-036931   P3566-C        QFX3500-48S4Q
CPU
PIC 0                BUILTIN     BUILTIN      48x 10G-SFP+
  Xcvr 12            REV 01      740-030658   AD1125A0438    SFP+-10G-USR
  Xcvr 13            REV 01      740-030658   AD1125A02GN    SFP+-10G-USR
PIC 1                BUILTIN     BUILTIN      4x 40G-QSFP+
PIC 2
MGMT BRD            REV 10      750-036946   BBAW0328       QFX3500-MGMT-RJ45-AFI
Power Supply 0       Rev 05      740-032091   WA13035        JPSU-650W-AC-AFI
Power Supply 1
Fan Tray 0
to Back Airflow     QFX3500 Fan Tray, Front
Fan Tray 1
to Back Airflow     QFX3500 Fan Tray, Front
Fan Tray 2
to Back Airflow     QFX3500 Fan Tray, Front

```

### show chassis hardware (QFX5100 Switch running Enhanced Layer 2 Software)

```

user@switch> show chassis hardware
Hardware inventory:
Item                Version  Part number  Serial number  Description
Chassis
Pseudo CB 0
Routing Engine 0
FPC 0                REV 02      650-049942   TB3113280048   QFX5100-24Q-2P
CPU
PIC 0                BUILTIN     BUILTIN      24x 40G-QSFP
  Xcvr 8              REV 01      740-032986   QA470143       QSFP+-40G-SR4
  Xcvr 14             REV 01      740-032986   QB500525       QSFP+-40G-SR4
PIC 1                REV 02      611-049555   RR3113310169   QFX-EM-4Q
  Xcvr 0              REV 01      740-032986   QC440904       QSFP+-40G-SR4
  Xcvr 1              REV 01      740-032986   QB240154       QSFP+-40G-SR4
  Xcvr 2              REV 01      740-035085   018110105      QSFP+-40G-LPBK
PIC 2                REV 02      611-049555   RR3113310209   QFX-EM-4Q
  Xcvr 0              REV 01      740-032986   QB190270       QSFP+-40G-SR4
  Xcvr 1              REV 01      740-035085   018110063      QSFP+-40G-LPBK
  Xcvr 2              REV 01      740-032986   QB210034       QSFP+-40G-SR4
Power Supply 0       REV 03      740-041741   1GA23110973    JPSU-650W-AC-AFO
Power Supply 1       REV 03      740-041741   1GA23090878    JPSU-650W-AC-AFO
Fan Tray 0
to Back Airflow - AFO QFX5100 Fan Tray 0, Front
Fan Tray 1
to Back Airflow - AFO QFX5100 Fan Tray 1, Front
Fan Tray 2
to Back Airflow - AFO QFX5100 Fan Tray 2, Front

```

Fan Tray 3  
to Back Airflow - AFO  
Fan Tray 4  
to Back Airflow - AFO

QFX5100 Fan Tray 3, Front  
QFX5100 Fan Tray 4, Front

## show chassis pic

|                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>List of Syntax</b>                                       | <a href="#">Syntax on page 1481</a><br><a href="#">Syntax (TX Matrix and TX Matrix Plus Routers) on page 1481</a><br><a href="#">Syntax (MX Series Routers and EX Series Switches) on page 1481</a><br><a href="#">Syntax (MX2010 and MX2010 3D Universal Edge Routers) on page 1481</a><br><a href="#">Syntax (PTX Series Packet Transport Router) on page 1481</a><br><a href="#">Syntax (QFX Series) on page 1481</a><br><a href="#">Syntax (OCX Series) on page 1481</a><br><a href="#">Syntax (ACX Series Universal Access Routers) on page 1481</a>                                                                                                                                                                                           |
| <b>Syntax</b>                                               | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax (TX Matrix and TX Matrix Plus Routers)</b>        | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i> &lt;lcc <i>number</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Syntax (MX Series Routers and EX Series Switches)</b>    | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i> &lt;all-members&gt;</code><br><code>&lt;local&gt;</code><br><code>&lt;member <i>member-id</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Syntax (MX2010 and MX2010 3D Universal Edge Routers)</b> | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax (PTX Series Packet Transport Router)</b>          | <code>show chassis pic transport fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Syntax (QFX Series)</b>                                  | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i> &lt;interconnect-device <i>name</i> (fpc-slot <i>slot-number</i>   pic-slot <i>slot-number</i>)&gt;</code><br><code>&lt;node-device <i>name</i> pic-slot <i>slot-number</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax (OCX Series)</b>                                  | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Syntax (ACX Series Universal Access Routers)</b>         | <code>show chassis pic fpc-slot <i>slot-number</i> pic-slot <i>slot-number</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>                                  | <p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced in Junos OS Release 9.0 for EX Series switches.</p> <p>Command introduced in Junos OS Release 11.1 for QFX Series.</p> <p>Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.</p> <p>Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 13.2 for PTX Series Packet Transport Routers.</p> <p>Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.</p> <p>Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p> |
| <b>Description</b>                                          | Display status information about the PIC installed in the specified Flexible PIC Concentrator (FPC) and PIC slot.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Options** **fpc-slot *slot-number***—Display information about the PIC in this particular FPC slot:

- On a TX Matrix router, if you specify the number of the T640 router by using the **lcc *number*** option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, replace ***slot-number*** with a value from 0 through 31.

Likewise, on a TX Matrix Plus router, if you specify the number of the T1600 router by using the **lcc *number*** option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, replace ***slot-number*** with a value from 0 through 31. For example, the following commands have the same result:

```
user@host> show chassis pic fpc-slot 1 lcc 1 pic-slot 1
user@host> show chassis pic fpc-slot 9 pic-slot 1
```

- M120 routers only—Replace ***slot-number*** with a value from 0 through 5.
- MX80 routers only—Replace ***slot-number*** with a value from 0 through 1.
- MX104 routers only—Replace ***slot-number*** with a value from 0 through 2.
- MX240 routers only—Replace ***slot-number*** with a value from 0 through 2.
- MX480 routers only—Replace ***slot-number*** with a value from 0 through 5.
- MX960 routers only—Replace ***slot-number*** with a value from 0 through 11.
- MX2010 routers only—Replace ***slot-number*** with a value from 0 through 9.
- MX2020 routers only—Replace ***slot-number*** with a value from 0 through 19.
- Other routers—Replace ***slot-number*** with a value from 0 through 7.
- EX Series switches:
  - EX3200 switches and EX4200 standalone switches—Replace ***slot-number*** with 0.
  - EX4200 switches in a Virtual Chassis configuration—Replace ***slot-number*** with a value from 0 through 9 (switch's member ID).
  - EX8208 switches—Replace ***slot-number*** with a value from 0 through 7 (line card).
  - EX8216 switches—Replace ***slot-number*** with a value from 0 through 15 (line card).
- QFX Series:
  - QFX3500, QFX3600, QFX5100, and OCX Series standalone switches—Replace ***slot-number*** with 0. In the command output, FPC refers to a line card. The FPC number equals the slot number for the line card.
  - QFabric systems—Replace ***slot-number*** with any number between 0 and 15. In the command output, FPC refers to a line card. The FPC number equals the slot number for the line card.

**all-members**—(MX Series routers and EX Series switches only) (Optional) Display PIC information for all member routers in the Virtual Chassis configuration.

**interconnect-device *name***—(QFabric systems only) (Optional) Display PIC information for a specified Interconnect device.

**lcc *number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display PIC information for a specified T640 router (or line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display PIC information for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

**local**—(MX Series routers and EX Series switches only) (Optional) Display PIC information for the local Virtual Chassis member.

**member *member-id***—(MX Series routers and EX Series switches only) (Optional) Display PIC information for the specified member of the Virtual Chassis configuration. Replace *member-id* with a value of 0 or 1.

**node-device *name***—(QFabric systems only) (Optional) Display PIC information for a specified Node device.

**pic-slot *slot-number***—Display information about the PIC in this particular PIC slot. For routers, replace *slot-number* with a value from 0 through 3. For EX3200 and EX4200 switches, replace *slot-number* with 0 for built-in network interfaces and 1 for interfaces on uplink modules. For EX8208 and EX8216 switches, replace *slot-number* with 0. For the QFX3500 standalone switch and the QFabric system, replace *slot-number* with 0 or 1.

**transport**—Display PIC information for optical transport network.

**Required Privilege Level** view

**Related Documentation**

- [request chassis pic](#)
- [show chassis hardware on page 1300](#)
- [100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 399](#)

**List of Sample Output** [show chassis pic fpc-slot pic-slot on page 1486](#)  
[show chassis pic fpc-slot pic-slot \(PIC Offline\) on page 1487](#)

[show chassis pic fpc-slot pic-slot \(FPC Offline\) on page 1487](#)  
[show chassis pic fpc-slot pic-slot \(FPC Not Present\) on page 1487](#)  
[show chassis pic fpc-slot pic-slot \(PIC Not Present\) on page 1487](#)  
[show chassis pic fpc-slot 3 pic-slot 0 \(M120 Router\) on page 1487](#)  
[show chassis pic fpc-slot pic-slot \(MX104 Router\) on page 1487](#)  
[show chassis pic fpc-slot pic-slot \(MX960 Router with Bidirectional Optics\) on page 1488](#)  
[show chassis pic fpc-slot pic-slot \(MX480 Router with 100-Gigabit Ethernet MIC\) on page 1488](#)  
[show chassis pic fpc-slot pic-slot \(MX240, MX480, MX960 Routers with Application Services Modular Line Card\) on page 1488](#)  
[show chassis pic fpc-slot pic-slot \(MX960 Router with MPC5EQ\) on page 1489](#)  
[show chassis pic fpc-slot pic-slot \(MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC\) on page 1489](#)  
[show chassis pic fpc-slot pic-slot \(PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC\) on page 1489](#)  
[show chassis pic fpc-slot pic-slot \(MX480 Router with MPC4E\) on page 1490](#)  
[show chassis pic fpc-slot pic-slot \(MX480 Router with OTN Interface\) on page 1490](#)  
[show chassis pic fpc-slot pic-slot \(MX2010 Router with OTN Interfaces\) on page 1490](#)  
[show chassis pic fpc-slot pic-slot \(MX2010 Router\) on page 1490](#)  
[show chassis pic fpc-slot pic-slot \(MX2020 Router\) on page 1491](#)  
[show chassis pic fpc-slot pic-slot \(MX2020 Router with MPC5EQ and MPC6E\) on page 1491](#)  
[show chassis pic fpc-slot pic-slot \(MX2020 Router with MPC6E and OTN MIC\) on page 1491](#)  
[show chassis pic fpc-slot pic-slot \(MX2020 Router with MPC4E\) on page 1492](#)  
[show chassis pic fpc-slot pic-slot \(T1600 Router with 100-Gigabit Ethernet PIC\) on page 1492](#)  
[show chassis pic fpc-slot pic-slot lcc \(TX Matrix Router\) on page 1492](#)  
[show chassis pic fpc-slot pic-slot lcc \(TX Matrix Plus Router\) on page 1493](#)  
[show chassis pic fpc-slot pic-slot \(Next-Generation SONET/SDH SFP\) on page 1493](#)  
[show chassis pic fpc-slot pic-slot \(12-Port T1/E1\) on page 1493](#)  
[show chassis pic fpc-slot 0 pic-slot 1 \(4x CHOC3 SONET CE SFP\) on page 1493](#)  
[show chassis pic fpc-slot 0 pic-slot 0 \(SONET/SDH OC3/STM1 \[Multi-Rate\] MIC with SFP\) on page 1494](#)  
[show chassis pic fpc-slot 3 pic-slot 0 \(8-port Channelized SONET/SDH OC3/STM1 \[Multi-Rate\] MIC with SFP\) on page 1494](#)  
[show chassis pic fpc-slot 5 pic-slot 0 \(4-Port Channelized SONET/SDH OC3/STM1 \[Multi-Rate\] MIC with SFP\) on page 1494](#)  
[show chassis pic fpc-slot 1 pic-slot 0 \(1-Port OC192/STM64 MIC with XFP\) on page 1495](#)  
[show chassis pic fpc-slot 1 pic-slot 2 \(8-Port DS3/E3 MIC\) on page 1495](#)  
[show chassis pic fpc-slot pic-slot \(OTN\) on page 1495](#)  
[show chassis pic fpc-slot pic-slot \(QFX3500 Switch\) on page 1495](#)  
[show chassis pic fpc-slot pic-slot \(QFX5100 Switches and OCX Series\) on page 1495](#)  
[show chassis pic interconnect-device fpc-slot pic-slot \(QFabric Systems\) on page 1495](#)  
[show chassis pic node-device fpc-slot pic-slot \(QFabric System\) on page 1496](#)  
[show chassis pic fpc-slot 0 pic-slot 1 \(ACX2000 Universal Access Router\) on page 1497](#)  
[show chassis pic FPC-slot 1 PIC-slot 0 \(MX Routers with Media Services Blade \[MSB\]\) on page 1497](#)



[show chassis pic FPC slot 1, PIC slot 2 \(MX Routers with Media Services Blade \[MSB\]\) on page 1497](#)

**Output Fields** Table 86 on page 1485 lists the output fields for the **show chassis pic** command. Output fields are listed in the approximate order in which they appear.

**Table 86: show chassis pic Output Fields**

| Field Name                                                   | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type                                                         | <p>PIC type.</p> <p><b>NOTE:</b> On the 1-port OC192/STM64 MICs with the SDH framing mode, the type is displayed as <b>MIC-3D-1STM64-XFP</b> and with the SONET framing mode, the type is displayed as <b>MIC-3D-1OC192-XFP</b>. By default, the 1-port OC192/STM64 MICs displays the type as <b>MIC-3D-1OC192-XFP</b>.</p>                                                                                                                                                                                                                                       |
| Account Layer2 Overhead                                      | (MX Series routers) Indicates whether functionality to count the Layer 2 overhead bytes in the interface statistics at the PIC level is enabled or disabled.                                                                                                                                                                                                                                                                                                                                                                                                      |
| ASIC type                                                    | Type of ASIC on the PIC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| State                                                        | <p>Status of the PIC. State is displayed only when a PIC is in the slot.</p> <ul style="list-style-type: none"> <li>• <b>Online</b>— PIC is online and running.</li> <li>• <b>Offline</b>—PIC is powered down.</li> </ul>                                                                                                                                                                                                                                                                                                                                         |
| PIC version                                                  | PIC hardware version.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Uptime                                                       | How long the PIC has been online.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package                                                      | (Multiservices PICs only) Services package supported: <b>Layer-2</b> or <b>Layer-3</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Port Number                                                  | Port number for the PIC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Cable Type                                                   | Type of cable connected to the port: <b>LH</b> , <b>LX</b> , or <b>SX</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| PIC Port Information (MX480 Router 100-Gigabit Ethernet CFP) | <p>Port-level information for the PIC.</p> <ul style="list-style-type: none"> <li>• Port—Port number</li> <li>• Cable type—Type of optical transceiver installed.</li> <li>• Fiber type—Type of fiber. SM is single-mode.</li> <li>• Xcvr vendor—Transceiver vendor name.</li> <li>• Xcvr vendor part number—Transceiver vendor part number.</li> <li>• Wavelength—Wavelength of the transmitted signal. Uplinks and downlinks are always 1550 nm. There is a separate fiber for each direction</li> <li>• Xcvr Firmware—Transceiver firmware version.</li> </ul> |

Table 86: show chassis pic Output Fields (*continued*)

| Field Name                                                       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIC Port Information (MX960 Router Bidirectional Optics )</b> | <p>Port-level information for the PIC.</p> <ul style="list-style-type: none"> <li>Port—Port number</li> <li>Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed. Uplink interfaces display -U. Down link interfaces display -D.</li> <li>Fiber type—Type of fiber. SM is single-mode.</li> <li>Xcvr vendor—Transceiver vendor name.</li> <li>Xcvr vendor part number—Transceiver vendor part number. <ul style="list-style-type: none"> <li>BX10-10-km bidirectional optics.</li> <li>BX40-40-km bidirectional optics.</li> <li>SFP-LX-40-km SFP optics.</li> </ul> </li> <li>Wavelength—Wavelength of the transmitted signal. Uplinks are always 1310 nm. Downlinks are either 1490 nm or 1550 nm.</li> </ul> |
| <b>PIC Port Information (Next-Generation SONET/SDH SFP)</b>      | <p>Port-level information for the next-generation SONET/SDH SFP PIC.</p> <ul style="list-style-type: none"> <li>Port—Port number.</li> <li>Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed.</li> <li>Fiber type—Type of fiber: <b>SM</b> (single-mode) or <b>MM</b> (multimode).</li> <li>Xcvr vendor—Transceiver vendor name.</li> <li>Xcvr vendor part number—Transceiver vendor part number.</li> <li>Wavelength—Wavelength of the transmitted signal. Next-generation SONET/SDH SFPs use 1310 nm.</li> </ul>                                                                                                                                                                                           |
| <b>PIC port information (MX104 router)</b>                       | <p>Port-level information for the PIC.</p> <ul style="list-style-type: none"> <li>Port—Port number</li> <li>Cable type—Type of optical transceiver installed.</li> <li>Fiber type—Type of fiber. SM is single-mode.</li> <li>Xcvr vendor—Transceiver vendor name.</li> <li>Xcvr vendor part number—Transceiver vendor part number.</li> <li>Wavelength—Wavelength of the transmitted signal.</li> <li>Xcvr Firmware—Firmware version of the transceiver.</li> </ul>                                                                                                                                                                                                                                                                           |
| <b>Multirate Mode</b>                                            | Rate-selectability status for the MIC: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Channelization</b>                                            | Indicates whether channelization is enabled or disabled on the DS3/E3 MIC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Sample Output

### show chassis pic fpc-slot pic-slot

```

user@host> show chassis pic fpc-slot 2 pic-slot 0
PIC fpc slot 2 pic slot 0 information:
Type                               10x 1GE(LAN), 1000 BASE

```

```

ASIC type           H chip
State               Online
PIC version         1.1
Uptime              1 day, 50 minutes, 58 seconds
PIC Port Information:
Port               Cable      Xcvr      Xcvr Vendor
Number            Type       Vendor Name  Part Number
0                 GIGE 1000EX  FINISAR CORP.  FTRJ8519P1BNL-J3
1                 GIGE 1000EX  FINISAR CORP.  FTRJ-8519-7D-JUN

```

#### show chassis pic fpc-slot pic-slot (PIC Offline)

```

user@host> show chassis pic fpc-slot 1 pic-slot 0
PIC fpc slot 1 pic slot 0 information:
State               Offline

```

#### show chassis pic fpc-slot pic-slot (FPC Offline)

```

user@host> show chassis pic fpc-slot 1 pic-slot 0
FPC 1 is not online

```

#### show chassis pic fpc-slot pic-slot (FPC Not Present)

```

user@host> show chassis pic fpc-slot 4 pic-slot 0
FPC slot 4 is empty

```

#### show chassis pic fpc-slot pic-slot (PIC Not Present)

```

user@host> show chassis pic fpc-slot 5 pic-slot 2
FPC 5, PIC 2 is empty

```

#### show chassis pic fpc-slot 3 pic-slot 0 (M120 Router)

```

user@host> show chassis pic fpc-slot 3 pic-slot 0
PC slot 3, PIC slot 0 information:
Type               2x G/E IQ, 1000 BASE
ASIC type          IQ GE 2 VLAN-TAG FPGA
State              Online
PIC version         1.16
Uptime              3 hours, 3 minutes

PIC Port Information:
Port               Cable      Xcvr      Xcvr Vendor
Number            Type       Vendor Name  Part Number
0                 GIGE 1000SX  FINISAR CORP.  FTRJ8519P1BNL-J3
1                 GIGE 1000SX  FINISAR CORP.  FTRJ-8519-7D-JUN

```

#### show chassis pic fpc-slot pic-slot (MX104 Router)

```

user@host> show chassis pic fpc-slot 1 pic-slot 1
FPC slot 1, PIC slot 1 information:
Type               10x 1GE(LAN) -E SFP
State              Online
PIC version         1.1
Uptime              1 hour, 30 minutes, 59 seconds

PIC port information:
Fiber              Xcvr vendor      Wave-      Xcvr
Port Cable type    type Xcvr vendor    part number  length
Firmware
3   GIGE 1000T      n/a  Methode Elec.  SP7041-M1-JN  n/a      0.0

```

|   |               |     |               |                  |         |     |
|---|---------------|-----|---------------|------------------|---------|-----|
| 6 | GIGE 1000LX10 | SM  | FINISAR CORP. | FTLF1318P2BTL-J1 | 1310 nm | 0.0 |
| 8 | GIGE 1000T    | n/a | Methode Elec. | SP7041-M1-JN     | n/a     | 0.0 |
| 9 | GIGE 1000T    | n/a | Methode Elec. | SP7041-M1-JN     | n/a     | 0.0 |

#### show chassis pic fpc-slot pic-slot (MX960 Router with Bidirectional Optics)

```

user@host> show chassis pic fpc-slot 4 pic-slot 1
FPC slot 4, PIC slot 1 information:
  Type                10x 1GE(LAN)
  State                Online
  PIC version          0.0
  Uptime               18 days, 5 hours, 41 minutes, 54 seconds

PIC port information:
  Port  Cable type      Fiber type  Xcvr vendor      Xcvr vendor      Wavelength
      Cable type      type      part number
0      SFP-1000BASE-BX10-D SM  SumitomoElectric SBP6H44-J3-BW-49 1490 nm
1      SFP-1000BASE-BX10-D SM  SumitomoElectric SBP6H44-J3-BW-49 1490 nm
2      SFP-1000BASE-BX10-D SM  SumitomoElectric SBP6H44-J3-BW-49 1490 nm
3      SFP-1000BASE-BX10-D SM  OCP              TRXBG1LXDBVM2-JW 1490 nm
4      SFP-1000BASE-BX10-D SM  OCP              TRXBG1LXDBVM2-JW 1490 nm
5      SFP-1000BASE-BX10-U SM  SumitomoElectric SBP6H44-J3-BW-31 1310 nm
6      SFP-1000BASE-BX10-U SM  SumitomoElectric SBP6H44-J3-BW-31 1310 nm
7      SFP-1000BASE-BX10-U SM  OCP              TRXBG1LXDBBMH-J1 1310 nm
8      SFP-1000BASE-BX10-U SM  OCP              TRXBG1LXDBBMH-J1 1310 nm
9      SFP-1000BASE-BX10-U SM  SumitomoElectric SBP6H44-J3-BW-31 1310 nm

```

#### show chassis pic fpc-slot pic-slot (MX480 Router with 100-Gigabit Ethernet MIC)

```

user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                1X100GE CFP
  State                Online
  PIC version          2.10
  Uptime               4 minutes, 48 seconds

PIC port information:
  Fiber
  Port  Cable type      type  Xcvr vendor      Xcvr vendor      Wavelength
      Cable type      type  part number
0      100GBASE LR4      SM    FINISAR CORP.    FTLC1181RDN3-J3 1310 nm

  Xcvr vendor
  firmware version
  1.8

```

#### show chassis pic fpc-slot pic-slot (MX240, MX480, MX960 Routers with Application Services Modular Line Card)

```

user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                AS-MXC
  State                Online
  PIC version          1.0
  Uptime               11 hours, 18 minutes, 3 seconds

```

**show chassis pic fpc-slot pic-slot (MX960 Router with MPC5EQ)**

```

user@host> show chassis pic fpc-slot 0 pic-slot 3
FPC slot 0, PIC slot 3 information:
  Type                1X100GE CFP2 OTN
  State                Online
  PIC version          0.0
  Uptime               1 hour, 22 minutes, 42 seconds

PIC port information:

```

|          |              | Fiber | Xcvr vendor | Wave-            | Xcvr        |
|----------|--------------|-------|-------------|------------------|-------------|
| Port     | Cable type   | type  | Xcvr vendor | part number      | length      |
| Firmware |              |       |             |                  |             |
| 0        | 100GBASE LR4 | n/a   | Oclaro Inc. | TRB5E20FNF-LF150 | 1309 nm 1.0 |

**show chassis pic fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)**

```

user@host> show chassis pic fpc-slot 3 pic-slot 0
FPC slot 3, PIC slot 0 information:
  Type                1X100GE DWDM CFP2-ACO
  State                Online
  PIC version          1.3
  Uptime               9 hours, 4 minutes, 43 seconds

PIC port information:

```

|                  |            | Fiber | Xcvr vendor | Wave-       | Xcvr         |
|------------------|------------|-------|-------------|-------------|--------------|
| Port             | Cable type | type  | Xcvr vendor | part number | length       |
| Firmware         |            |       |             |             |              |
| 0                | 100G LH    | SM    | OCLARO      | TRB100AJ-01 | 1528.77 nm - |
| 1568.36 nm 20.10 |            |       |             |             |              |

**show chassis pic fpc-slot pic-slot (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)**

```

user@host > show chassis pic fpc-slot 4 pic-slot 0
FPC slot 4, PIC slot 0 information:
  Type                5X100GE DWDM CFP2-ACO
  State                Online
  PIC version          1.17
  Uptime               1 day, 5 hours, 15 minutes, 17 seconds

PIC port information:

```

|                 |            | Fiber | Xcvr vendor     | Wave-        | Xcvr         |
|-----------------|------------|-------|-----------------|--------------|--------------|
| Port            | Cable type | type  | Xcvr vendor     | part number  | length       |
| Firmware        |            |       |                 |              |              |
| 0               | 100G LH    | SM    | MULTILANE SAL   | ML4030-ACO-2 | 1528.77 nm - |
| 1568.36 nm 1.0  |            |       |                 |              |              |
| 1               | 100G LH    | SM    | MULTILANE SAL   | ML4030-ACO-2 | 1528.77 nm - |
| 1568.36 nm 1.0  |            |       |                 |              |              |
| 2               | 100G LH    | SM    | JUNIPER-FUJITSU | FIM38500/222 | 1528.77 nm - |
| 1568.36 nm 1.16 |            |       |                 |              |              |
| 3               | 100G LH    | SM    | FUJITSU         | FIM38500/222 | 1528.77 nm - |
| 1568.36 nm 1.16 |            |       |                 |              |              |
| 4               | 100G LH    | SM    | FUJITSU         | FIM38500/222 | 1528.77 nm - |
| 1568.36 nm 1.16 |            |       |                 |              |              |

**show chassis pic fpc-slot pic-slot (MX480 Router with MPC4E)**

```

user@host> show chassis pic fpc-slot 3 pic-slot 0
FPC slot 3, PIC slot 0 information:
  Type                4x10GE SFPP
  State                Online
  PIC version          0.0
  Uptime               41 seconds

PIC port information:

```

|          |            | Fiber | Xcvr vendor  | Wave-          | Xcvr       |
|----------|------------|-------|--------------|----------------|------------|
| Port     | Cable type | type  | Xcvr vendor  | part number    | length     |
| Firmware |            |       |              |                |            |
| 0        | 10GBASE SR | MM    | OPNEXT, INC. | TRS2001EM-0014 | 850 nm 0.0 |
| 1        | 10GBASE SR | MM    | OPNEXT, INC. | TRS2001EM-0014 | 850 nm 0.0 |

**show chassis pic fpc-slot pic-slot (MX480 Router with OTN Interface)**

```

user@host> show chassis pci fpc-slot 4 pic-slot 0
FPC slot 4, PIC slot 0 information:
  Type                12X10GE SFPP OTN
  State                Online
  PIC version          0.0
  Uptime               5 hours, 28 minutes, 23 seconds

PIC port information:

```

|          |            | Fiber | Xcvr vendor   | Wave-            | Xcvr       |
|----------|------------|-------|---------------|------------------|------------|
| Port     | Cable type | type  | Xcvr vendor   | part number      | length     |
| Firmware |            |       |               |                  |            |
| 0        | 10GBASE SR | MM    | FINISAR CORP. | FTLX8571D3BNL-J1 | 850 nm 0.0 |
| 1        | 10GBASE SR | MM    | FINISAR CORP. | FTLX8571D3BCL-J1 | 850 nm 0.0 |
| 2        | 10GBASE SR | MM    | OPNEXT, INC.  | TRS2001EM-0014   | 850 nm 0.0 |

**show chassis pic fpc-slot pic-slot (MX2010 Router with OTN Interfaces)**

```

user@host> show chassis pic fpc-slot 9 pic-slot 0
FPC slot 9, PIC slot 0 information:
  Type                2X100GE CFP2 OTN
  State                Online
  PIC version          1.9
  Uptime               3 hours, 56 minutes, 16 seconds

PIC port information:

```

|          |                | Fiber | Xcvr vendor | Wave-        | Xcvr        |
|----------|----------------|-------|-------------|--------------|-------------|
| Port     | Cable type     | type  | Xcvr vendor | part number  | length      |
| Firmware |                |       |             |              |             |
| 0        | 100GBASE LR4-D | SM    | FUJITSU     | FIM37300/222 | 1310 nm 1.3 |
| 1        | 100GBASE SR10  | MM    | AVAGO       | AFBR-8420Z   | n/a 1.0     |

**show chassis pic fpc-slot pic-slot (MX2010 Router)**

```

user@host> show chassis pic fpc-slot 9 pic-slot 3

```

FPC slot 9, PIC slot 3 information:

```
Type                1X100GE CFP
Account Layer2 Overhead Enabled
State                Online
PIC version          0.0
Uptime               14 hours, 51 seconds
```

#### show chassis pic fpc-slot pic-slot (MX2020 Router)

user@host> show chassis pic fpc-slot 19 pic-slot 3

FPC slot 19, PIC slot 3 information:

```
Type                4x 10GE(LAN) SFP+
Account Layer2 Overhead Enabled
State                Online
PIC version          0.0
Uptime               1 day, 11 hours, 26 minutes, 36 seconds
```

PIC port information:

|          |            |    | Fiber            |                | Xcvr vendor | Wave-  | Xcvr |
|----------|------------|----|------------------|----------------|-------------|--------|------|
| Port     | Cable type |    | type             | Xcvr vendor    | part number | length |      |
| Firmware |            |    |                  |                |             |        |      |
| 0        | 10GBASE SR | MM | SumitomoElectric | SPP5200SR-J6-M | 850 nm      | 0.0    |      |
| 1        | 10GBASE SR | MM | SumitomoElectric | SPP5200SR-J6-M | 850 nm      | 0.0    |      |
| 2        | 10GBASE SR | MM | SumitomoElectric | SPP5200SR-J6-M | 850 nm      | 0.0    |      |
| 3        | 10GBASE SR | MM | SumitomoElectric | SPP5200SR-J6-M | 850 nm      | 0.0    |      |

#### show chassis pic fpc-slot pic-slot (MX2020 Router with MPC5EQ and MPC6E)

user@host> show chassis pic fpc-slot 18 pic-slot 2

FPC slot 18, PIC slot 2 information:

```
Type                3X40GE QSFP
State                Online
PIC version          0.0
Uptime               6 minutes, 31 seconds
```

PIC port information:

|          |             |    | Fiber |                  | Xcvr vendor | Wave-  | Xcvr |
|----------|-------------|----|-------|------------------|-------------|--------|------|
| Port     | Cable type  |    | type  | Xcvr vendor      | part number | length |      |
| Firmware |             |    |       |                  |             |        |      |
| 0        | 40GBASE SR4 | MM | AVAGO | AFBR-79E4Z-D-JU2 | 850 nm      | 0.0    |      |
| 1        | 40GBASE SR4 | MM | AVAGO | AFBR-79E4Z-D-JU2 | 850 nm      | 0.0    |      |
| 2        | 40GBASE SR4 | MM | AVAGO | AFBR-79E4Z-D-JU2 | 850 nm      | 0.0    |      |

#### show chassis pic fpc-slot pic-slot (MX2020 Router with MPC6E and OTN MIC)

user@host> show chassis pic fpc-slot 3 pic-slot 0

FPC slot 0, PIC slot 1 information:

```
Type                24X10GE SFPP OTN
State                Online
PIC version          1.1
Uptime               1 hour, 33 minutes, 59 seconds
```

PIC port information:

|          |            | Fiber |                  | Xcvr vendor      | Wave-   | Xcvr |
|----------|------------|-------|------------------|------------------|---------|------|
| Port     | Cable type | type  | Xcvr vendor      | part number      | length  |      |
| Firmware |            |       |                  |                  |         |      |
| 7        | 10GBASE SR | MM    | SumitomoElectric | SPP5200SR-J6-M   | 850 nm  | 0.0  |
| 9        | 10GBASE SR | MM    | FINISAR CORP.    | FTLX8571D3BNL-J1 | 850 nm  | 0.0  |
| 12       | 10GBASE LR | SM    | FINISAR CORP.    | FTLX1472M3BNL-J3 | 1310 nm | 0.0  |
| 20       | 10GBASE ZR | SM    | FINISAR CORP.    | FTLX1871M3BNL-J3 | 1550 nm | 0.0  |
| 21       | 10GBASE ER | SM    | FINISAR CORP.    | FTLX1671D3BTL-J4 | 1550 nm | 0.0  |
| 22       | 10GBASE LR | SM    | SOURCEPHOTONICS  | SPP10SLREDFCJNP  | 1310 nm | 0.0  |
| 23       | 10GBASE LR | SM    | FINISAR CORP.    | FTLX1471D3BNL-J1 | 1310 nm | 0.0  |

#### show chassis pic fpc-slot pic-slot (MX2020 Router with MPC4E)

```

user@host> show chassis pic fpc-slot 14 pic-slot 0
FPC slot 14, PIC slot 1 information:
  Type                1X100GE CFP
  State                Online
  PIC version          0.0
  Uptime               1 day, 2 hours, 19 minutes, 18 seconds

PIC port information:

```

|          |               | Fiber |                  | Xcvr vendor      | Wave-  | Xcvr |
|----------|---------------|-------|------------------|------------------|--------|------|
| Port     | Cable type    | type  | Xcvr vendor      | part number      | length |      |
| Firmware |               |       |                  |                  |        |      |
| 0        | 100GBASE SR10 | MM    | Reflex Photonics | CF-X12-C11801-50 | 860 nm | 4.7  |

#### show chassis pic fpc-slot pic-slot (T1600 Router with 100-Gigabit Ethernet PIC)

```

user@host> run show chassis pic fpc-slot 3 pic-slot 1
FPC slot 3, PIC slot 1 information:
  Type                100GE SLOT1
  ASIC type            Brooklyn 100GE FPGA
  State                Online
  PIC version          1.3
  Uptime               10 minutes, 44 seconds

PIC port information:

```

| Port | Cable type   | Fiber type | Xcvr vendor | Xcvr vendor part number | Wavelength |
|------|--------------|------------|-------------|-------------------------|------------|
| 0    | 100GBASE LR4 | SM         | Opnext Inc. | TRC5E20ENFSF000F        | 1310 nm    |

#### show chassis pic fpc-slot pic-slot lcc (TX Matrix Router)

```

user@host> show chassis pic fpc-slot 1 pic-slot 1 lcc 0
lcc0-re0:
-----
PIC fpc slot 1 pic slot 1 information:
  Type                4x OC-3 SONET, SMIR
  ASIC type            D chip
  State                Online
  PIC version          1.2
  Uptime               5 days, 2 hours, 12 minutes, 8 seconds

```



**show chassis pic fpc-slot pic-slot lcc (TX Matrix Plus Router)**

```

user@host> show chassis pic pic-slot 0 fpc-slot 8
lcc0-re0:
-----
FPC slot 8, PIC slot 0 information:
  Type                1x 10GE(LAN/WAN)
  State                Online
  Uptime               2 hours, 46 minutes, 23 seconds

PIC port information:

  Port  Cable type      Fiber
                                type  Xcvr vendor      part number      Wavelength
  ---  -
  0     10GBASE ZR       SM   Opnext Inc.      TRF7061BN-LF150  1550 nm
  0     10GBASE ZR       SM   FINISAR CORP.    FTRX-1811-3-J2   1550 nm

```

**show chassis pic fpc-slot pic-slot (Next-Generation SONET/SDH SFP)**

```

user@host> show chassis pic fpc-slot 4 pic-slot 0
FPC slot 4, PIC slot 0 information:
  Type                4x OC-3 1x OC-12 SFP
  ASIC type            D FPGA
  State                Online
  PIC version          1.3
  Uptime               1 day, 50 minutes, 4 seconds

PIC port information:

  Port  Cable type      Fiber
                                type  Xcvr vendor      Xcvr vendor
                                type  Xcvr vendor      part number      Wavelength
  ---  -
  0     OC48 short reach SM   FINISAR CORP.    FTRJ1321P1BTL-J2 1310 nm
  1     OC3 short reach  MM   OCP              TRPA03MM3BAS-JE 1310 nm
  2     OC3 short reach  MM   OCP              TRXA03MM3BAS-JW 1310 nm
  3     OC12 inter reach SM   FINISAR CORP.    FTLF1322P1BTR   1310 nm

```

**show chassis pic fpc-slot pic-slot (12-Port T1/E1)**

```

user@host> show chassis pic fpc-slot 0 pic-slot 3
FPC slot 0, PIC slot 3 information:
  Type                12x T1/E1 CE
  State                Online
  PIC version          1.1
  CPU load average     1 percent
  Interrupt load average 0 percent
  Total DRAM size      128 MB
  Memory buffer utilization 100 percent
  Memory heap utilization 4 percent
  Uptime               1 day, 22 hours, 28 minutes, 12 seconds
  Internal Clock Synchronization Normal

```

**show chassis pic fpc-slot 0 pic-slot 1 (4x CHOC3 SONET CE SFP)**

```

user@host> show chassis pic fpc-slot 0 pic-slot 1
FPC slot 0, PIC slot 1 information:
  Type                4x CHOC3 SONET CE SFP
  State                Online
  PIC version          1.3
  CPU load average     1 percent
  Interrupt load average 0 percent
  Total DRAM size      128 MB

```

```

Memory buffer utilization    99 percent
Memory heap utilization     4 percent
Uptime                      1 day, 22 hours, 55 minutes, 37 seconds
Internal Clock Synchronization Normal

```

PIC port information:

| Port | Cable type      | Fiber type | Xcvr vendor | Xcvr vendor part number | Wavelength |
|------|-----------------|------------|-------------|-------------------------|------------|
| 0    | OC3 short reach | MM         | AVAGO       | HFBR-57E0P-JU2          | n/a        |
| 1    | OC3 short reach | MM         | AVAGO       | HFBR-57E0P-JU2          | n/a        |
| 3    | OC3 long reach  | SM         | OPNEXT INC  | TRF5456AVLB314          | 1310 nm    |

### show chassis pic fpc-slot 0 pic-slot 0 (SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```

user@host> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
Type                MIC-3D-80C30C12-40C48
State               Online
PIC version         1.8
Uptime              3 days, 22 hours, 3 minutes, 50 seconds

```

PIC port information:

| Port | Cable type       | Fiber type | Xcvr vendor  | Xcvr vendor part number | Wavelength |
|------|------------------|------------|--------------|-------------------------|------------|
| 1    | OC12 inter reach | SM         | FINISAR CORP | FTRJ1322P1BTR-J3        | 1310 nm    |
| 7    | OC12 inter reach | SM         | FINISAR CORP | FTRJ1322P1BTR-J3        | 1310 nm    |

Multirate Mode Enabled

### show chassis pic fpc-slot 3 pic-slot 0 (8-port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```

user@host> show chassis pic fpc-slot 3 pic-slot 0
FPC slot 3, PIC slot 0 information:
Type                MIC-3D-8CHOC3-4CHOC12
State               Online
PIC version         1.9
Uptime              1 hour, 21 minutes, 24 seconds

```

PIC port information:

| Port | Cable type       | Fiber type | Xcvr vendor   | Xcvr vendor part number | Wavelength |
|------|------------------|------------|---------------|-------------------------|------------|
| 0    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |
| 1    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |
| 2    | OC12 inter reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J2        | 1310 nm    |
| 4    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |
| 5    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |
| 6    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |
| 7    | OC12 short reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |

### show chassis pic fpc-slot 5 pic-slot 0 (4-Port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```

user@host> show chassis pic fpc-slot 5 pic-slot 0
FPC slot 5, PIC slot 0 information:
Type                MIC-3D-4CHOC3-2CHOC12
State               Online
PIC version         1.9
Uptime              1 hour, 21 minutes

```

PIC port information:

| Port | Cable type       | Fiber type | Xcvr vendor   | Xcvr vendor part number | Wavelength |
|------|------------------|------------|---------------|-------------------------|------------|
| 1    | OC12 inter reach | SM         | FINISAR CORP. | FTRJ1322P1BTR-J3        | 1310 nm    |

```

2      OC12 inter reach SM   FINISAR CORP.      FTRJ1322P1BTR-J3  1310 nm
3      OC12 short reach  SM   FINISAR CORP.      FTRJ1322P1BTR-J3  1310 nm

```

#### show chassis pic fpc-slot 1 pic-slot 0 (1-Port OC192/STM64 MIC with XFP)

```

user@host> show chassis pic fpc-slot 1 pic-slot 0
FPC slot 1, PIC slot 0 information:
  Type                MIC-3D-10C192-XFP
  State                Online
  PIC version          1.2
  Uptime               1 day, 11 hours, 4 minutes, 6 seconds

PIC port information:
  Port  Cable type      Fiber type  Xcvr vendor  Xcvr vendor  part number  Wavelength
  0      OC192 short reach n/a    FINISAR CORP.  FTLX1412M3BCL-J3  1310 nm

```

#### show chassis pic fpc-slot 1 pic-slot 2 (8-Port DS3/E3 MIC)

```

user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                MIC-3D-8DS3-E3
  State                Online
  PIC version          1.10
  Uptime               4 days, 1 hour, 29 minutes, 19 seconds
  Channelization Mode  Disabled

```

#### show chassis pic fpc-slot pic-slot (OTN)

```

user@host> show chassis pic fpc-slot 5 pic-slot 0
PIC fpc slot 5 pic slot 0 information:
  Type                1x10GE(LAN),OTN
  ASIC type            H chip
  State                Online
  PIC version          1.0
  Uptime               5 minutes, 50 seconds

```

#### show chassis pic fpc-slot pic-slot (QFX3500 Switch)

```

user@switch> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
Type 48x 10G-SFP+ Builtin
State Online
Uptime 3 days, 3 hours, 5 minutes, 20 seconds

```

#### show chassis pic fpc-slot pic-slot (QFX5100 Switches and OCX Series)

```

user@switch> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
  Type                Unknown Builtin
  State                Online
  Uptime               1 day, 17 hours, 5 minutes, 9 seconds

```

#### show chassis pic interconnect-device fpc-slot pic-slot (QFabric Systems)

```

user@switch> show chassis pic interconnect-device interconnect1 fpc-slot 9 pic-slot 0
FPC slot 9, PIC slot 0 information:
  Type                16x 40G-GE Builtin
  State                Online
  Uptime               2 hours, 47 minutes, 40 seconds

```

**show chassis pic node-device fpc-slot pic-slot (QFabric System)**

```

user@switch> show chassis pic node-device node1 pic-slot 0
FPC slot node1, PIC slot 0 information:
Type                               48x 10G-SFP+Builtn
State                              Online
Uptime                             2 hours, 52 minutes, 37 seconds

```

## PIC port information:

| Port | Cable type | Fiber type | Xcvr vendor      | Xcvr vendor part number | Wavelength |
|------|------------|------------|------------------|-------------------------|------------|
| 0    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 1    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 2    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 3    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 4    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 5    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 6    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 7    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 8    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 9    | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 10   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 11   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 12   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 13   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 14   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 15   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 16   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 17   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 18   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 19   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 20   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 21   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 22   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 23   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 24   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 25   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 26   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 27   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 28   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 29   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 30   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 31   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 32   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 33   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 34   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 35   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 36   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 37   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 38   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 39   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 40   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 41   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 42   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 43   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 44   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 45   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 46   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |
| 47   | 10GBASE SR | MM         | SumitomoElectric | SPP5101SR-J3            | 850 nm     |

**show chassis pic fpc-slot 0 pic-slot 1 (ACX2000 Universal Access Router)**

```
user@host> show chassis pic fpc-slot 0 pic-slot 1
FPC slot 0, PIC slot 1 information:
  Type                8x 1GE(LAN) RJ45 Builtin
  State                Online
  Uptime               6 days, 2 hours, 51 minutes, 11 seconds
```

**show chassis pic FPC-slot 1 PIC-slot 0 (MX Routers with Media Services Blade [MSB])**

```
user@switch> show chassis pic fpc-slot 1 pic-slot 0
FPC slot 1, PIC slot 0 information:
  Type                AS-MSC
  State                Online
  PIC version          1.6
  Uptime               11 hours, 17 minutes, 56 seconds
```

**show chassis pic FPC slot 1, PIC slot 2 (MX Routers with Media Services Blade [MSB])**

```
user@switch> show chassis pic fpc-slot 1 pic-slot 2
Type                AS-MXC
State                Online
PIC version          1.0
Uptime               11 hours, 18 minutes, 3 seconds
```

## show iccp

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show iccp</b> <brief   detail><br><b>logical-system</b> < <i>system-name</i>   all>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.0 for the MX Series.<br>Support for logical systems added in Junos OS Release 14.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Description</b>              | Display Inter-chassis Control Protocol (ICCP) information about the multichassis link aggregation group (MC-LAG) peers, including the state of the TCP connection, Bidirectional Forwarding Detection protocol, backup liveness peer status, and mcnsopd, lacpd, and eswd applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b>logical-system</b> &lt;<i>system-name</i>   all&gt;—(Optional) Display information for a specified logical system or all systems.</p> <p><b>none</b>—Display ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and mcnsopd, lacpd, and eswd applications.</p> <p><b>brief</b>—Display brief ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and mcnsopd, lacpd, and eswd applications.</p> <p><b>detail</b>—Display detailed ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and mcnsopd, lacpd, and eswd applications.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Understanding Multichassis Link Aggregation</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>List of Sample Output</b>    | <a href="#">show iccp on page 1499</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Output Fields</b>            | <a href="#">Table 87 on page 1498</a> lists the output fields for the <b>show iccp</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

Table 87: show iccp

| Field Name                            | Field Description                                                                                                                  |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Redundancy Group Information for peer | Aggregated Ethernet interface name.                                                                                                |
| TCP Connection                        | Specifies if the TCP connection between the peers hosting the MC-LAG is up or down.                                                |
| Status                                | Displays the state of the redundancy group: up or down                                                                             |
| Redundancy Group ID                   | Displays the redundancy group identifier that is used to associate with multiple chassis that perform similar failover operations. |

Table 87: show iccp (*continued*)

| Field Name                  | Field Description                                                                                                   |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------|
| Status                      | Displays the state of the redundancy group: up or down                                                              |
| Client Application          | Specifies information regarding the state of the mcnsnoopd and eswd client applications.                            |
| Redundancy Group IDs Joined | Denotes the redundancy group unique identifier that is associated for the particular client application or process. |

## Sample Output

### show iccp

```
user@switch> show iccp
Redundancy Group Information for peer 7.7.7.1
  TCP Connection      : Established
  Liveliness Detection : Up

  Redundancy Group ID      Status
    100                    Up

Client Application: 12ald_iccpd_client
Redundancy Group IDs Joined: 100

Client Application: 1acpd
Redundancy Group IDs Joined: 100
```

## show interfaces (Adaptive Services)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces <i>interface-type</i> &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | Display status information about the specified adaptive services interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><b><i>interface-type</i></b>—On M Series and T Series routers, the interface type is <b>sp-<i>fpc/pic/port</i></b>.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces (Adaptive Services) on page 1505</a></p> <p><a href="#">show interfaces brief (Adaptive Services) on page 1505</a></p> <p><a href="#">show interfaces detail (Adaptive Services) on page 1505</a></p> <p><a href="#">show interfaces extensive (Adaptive Services) on page 1506</a></p>                                                                                                                                                                                                                                                                                   |
| <b>Output Fields</b>            | Table 88 on page 1500 lists the output fields for the <b>show interfaces</b> (adaptive services and redundant adaptive services) command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                        |

**Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields**

| Field Name                | Field Description                                                                                                                    | Level of Output              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Physical Interface        |                                                                                                                                      |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                      | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the "Enabled Field" section under <i>Common Output Fields Description</i> . | All levels                   |
| <b>Interface index</b>    | Physical interface's index number, which reflects its initialization sequence.                                                       | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                        | <b>detail extensive none</b> |



Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                    | Level of Output              |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                    | <b>detail extensive</b>      |
| <b>Type</b>                    | Encapsulation being used on the interface.                                                                                                                                                                                                           | All levels                   |
| <b>Link-level type</b>         | Encapsulation being used on the physical interface.                                                                                                                                                                                                  | All levels                   |
| <b>MTU</b>                     | MTU size on the physical interface.                                                                                                                                                                                                                  | All levels                   |
| <b>Clocking</b>                | Reference clock source: can be <b>Internal</b> or <b>External</b> .                                                                                                                                                                                  | All levels                   |
| <b>Speed</b>                   | Speed at which the interface is running.                                                                                                                                                                                                             | All levels                   |
| <b>Device flags</b>            | Information about the physical device. Possible values are described in the "Device Flags" section under <i>Common Output Fields Description</i> .                                                                                                   | All levels                   |
| <b>Interface flags</b>         | Information about the interface. Possible values are described in the "Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                      | All levels                   |
| <b>Link type</b>               | Physical interface link type: <b>Full-Duplex</b> or <b>Half-Duplex</b> .                                                                                                                                                                             | <b>detail extensive none</b> |
| <b>Link flags</b>              | Information about the link. Possible values are described in the "Link Flags" section under <i>Common Output Fields Description</i> .                                                                                                                | <b>detail extensive none</b> |
| <b>Physical info</b>           | Information about the physical interface.                                                                                                                                                                                                            | <b>detail extensive</b>      |
| <b>Hold-times</b>              | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                  | <b>detail extensive</b>      |
| <b>Current address</b>         | Configured MAC address.                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Hardware address</b>        | MAC address of the hardware.                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Alternate link address</b>  | Backup address of the link.                                                                                                                                                                                                                          | <b>detail extensive none</b> |
| <b>Last flapped</b>            | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hour:minute:second timezone (hour:minute:second ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> . | <b>detail extensive none</b> |
| <b>Input Rate</b>              | Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                    | None specified               |
| <b>Output Rate</b>             | Output rate in bps and pps.                                                                                                                                                                                                                          | None specified               |
| <b>Statistics last cleared</b> | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                    | <b>detail extensive</b>      |

Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Level of Output              |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Traffic statistics</b> | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b>      |
| <b>Input errors</b>       | <p>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Frames received smaller than the runt threshold.</li> <li>• <b>Giants</b>—Frames received larger than the giant threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul>                                       | <b>extensive</b>             |
| <b>Output errors</b>      | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>MTU errors</b>—Number of packets larger than the MTU threshold.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>             |
| <b>Logical Interface</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| <b>Logical interface</b>  | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | All levels                   |
| <b>Index</b>              | Logical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP interface index number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |

Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                           | Level of Output              |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Flags</b>              | Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                             | All levels                   |
| <b>Encapsulation</b>      | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                     | All levels                   |
| <b>Input packets</b>      | Number of packets received on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                        | None specified               |
| <b>Output packets</b>     | Number of packets transmitted on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                     | None specified               |
| <b>Traffic statistics</b> | <p>Number and rate of bytes and packets received and transmitted on the logical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | <b>detail extensive</b>      |
| <b>Local statistics</b>   | Statistics for traffic received from and transmitted to the Routing Engine. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes awhile (generally, less than 1 second) for this counter to stabilize.                                                                                                                                                                          | <b>detail extensive</b>      |
| <b>Transit statistics</b> | Statistics for traffic transiting the router. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes generally less than 1 second for the counter to stabilize.                                                                                                                                                                                                                   | <b>detail extensive</b>      |
| <b>protocol-family</b>    | Protocol family configured on the logical interface. If the protocol is <b>inet</b> , the IP address of the interface is also displayed.                                                                                                                                                                                                                                                                                                                    | <b>brief</b>                 |
| <b>Protocol</b>           | Protocol family configured on the logical interface, such as <b>iso</b> , <b>inet6</b> , <b>mpls</b> .                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive none</b> |
| <b>MTU</b>                | MTU size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive</b>      |
| <b>Route table</b>        | Routing table in which the logical interface address is located. For example, <b>0</b> refers to the routing table <b>inet.0</b> .                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b>      |
| <b>Flags</b>              | Information about the protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                    | <b>detail extensive none</b> |
| <b>Addresses, Flags</b>   | Information about the address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Destination</b>        | IP address of the remote side of the connection.                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive none</b> |
| <b>Local</b>              | IP address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive none</b> |

**Table 88: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields**  
*(continued)*

| Field Name        | Field Description                                                 | Level of Output              |
|-------------------|-------------------------------------------------------------------|------------------------------|
| <b>Broadcast</b>  | Broadcast address.                                                | <b>detail extensive none</b> |
| <b>Generation</b> | Unique number for use by Juniper Networks technical support only. | <b>detail extensive</b>      |

## Sample Output

### show interfaces (Adaptive Services)

```

user@host> show interfaces sp-1/2/0
Physical interface: sp-1/2/0, Enabled, Physical link is Up
  Interface index: 147, SNMP ifIndex: 72
  Type: Adaptive-Services, Link-level type: Adaptive-Services, MTU: 9192,
  Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Link type      : Full-Duplex
  Link flags     : None
  Last flapped   : 2006-03-06 11:37:18 PST (00:57:29 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)

Logical interface sp-1/2/0.16383 (Index 68) (SNMP ifIndex 73)
  Flags: Point-To-Point SNMP-Traps Encapsulation: Adaptive-Services
  Input packets : 3057
  Output packets: 3044
  Protocol inet, MTU: 9192
  Flags: Receive-options, Receive-TTL-Exceeded
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 10.0.0.34, Local: 10.0.0.1

```

### show interfaces brief (Adaptive Services)

```

user@host> show interfaces sp-1/2/0 brief
Physical interface: sp-1/2/0, Enabled, Physical link is Up
  Type: Adaptive-Services, Link-level type: Adaptive-Services, MTU: 9192,
  Clocking: Unspecified, Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000

Logical interface sp-1/2/0.16383
  Flags: Point-To-Point SNMP-Traps Encapsulation: Adaptive-Services
  inet 10.0.0.1      --> 10.0.0.34

```

### show interfaces detail (Adaptive Services)

```

user@host> show interfaces sp-1/2/0 detail
Physical interface: sp-1/2/0, Enabled, Physical link is Up
  Interface index: 147, SNMP ifIndex: 72, Generation: 30
  Type: Adaptive-Services, Link-level type: Adaptive-Services, MTU: 9192,
  Clocking: Unspecified, Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Link type      : Full-Duplex
  Link flags     : None
  Physical info   : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: Unspecified, Hardware address: Unspecified
  Alternate link address: Unspecified
  Last flapped   : 2006-03-06 11:37:18 PST (00:57:56 ago)
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          125147          0 bps
    Output bytes  :          1483113          0 bps
    Input packets :           3061          0 pps
    Output packets:           3048          0 pps

```

```

Logical interface sp-1/2/0.16383 (Index 68) (SNMP ifIndex 73) (Generation 7)
Flags: Point-To-Point SNMP-Traps Encapsulation: Adaptive-Services
Traffic statistics:
  Input bytes :          125147
  Output bytes :        1483113
  Input packets:          3061
  Output packets:        3048
Local statistics:
  Input bytes :          125147
  Output bytes :        1483113
  Input packets:          3061
  Output packets:        3048
Transit statistics:
  Input bytes :           0          0 bps
  Output bytes :           0          0 bps
  Input packets:           0          0 pps
  Output packets:          0          0 pps
Protocol inet, MTU: 9192, Generation: 20, Route table: 1
Flags: Receive-options, Receive-TTL-Exceeded
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 10.0.0.34, Local: 10.0.0.1, Broadcast: Unspecified,
  Generation: 22

```

#### show interfaces extensive (Adaptive Services)

```

user@host> show interfaces sp-1/2/0 extensive
Physical interface: sp-1/2/0, Enabled, Physical link is Up
Interface index: 147, SNMP ifIndex: 72, Generation: 30
Type: Adaptive-Services, Link-level type: Adaptive-Services, MTU: 9192,
Clocking: Unspecified, Speed: 800mbps
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Link type : Full-Duplex
Link flags : None
Physical info : Unspecified
Hold-times : Up 0 ms, Down 0 ms
Current address: Unspecified, Hardware address: Unspecified
Alternate link address: Unspecified
Last flapped : 2006-03-06 11:37:18 PST (00:58:40 ago)
Statistics last cleared: Never
Traffic statistics:
  Input bytes :          125547          0 bps
  Output bytes :        1483353          0 bps
  Input packets:          3065          0 pps
  Output packets:        3052          0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runt: 0, Giants: 0,
  Policed discards: 0, Resource errors: 0
Output errors:
  Carrier transitions: 2, Errors: 0, Drops: 0, MTU errors: 0,
  Resource errors: 0

Logical interface sp-1/2/0.16383 (Index 68) (SNMP ifIndex 73) (Generation 7)
Flags: Point-To-Point SNMP-Traps Encapsulation: Adaptive-Services
Traffic statistics:
  Input bytes :          125547
  Output bytes :        1483353
  Input packets:          3065
  Output packets:        3052
Local statistics:

```

```
Input bytes :          125547
Output bytes :        1483353
Input packets:          3065
Output packets:        3052
Transit statistics:
Input bytes :              0          0 bps
Output bytes :              0          0 bps
Input packets:              0          0 pps
Output packets:              0          0 pps
Protocol inet, MTU: 9192, Generation: 20, Route table: 1
Flags: Receive-options, Receive-TTL-Exceeded
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.0.0.34, Local: 10.0.0.1, Broadcast: Unspecified,
Generation: 22
```

## show interfaces (Aggregated Ethernet)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces <i>aenumber</i> &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | (M Series, T Series, and MX Series routers only) Display status information about the specified aggregated Fast Ethernet or Gigabit Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b><i>aenumber</i></b>—Display standard information about the specified aggregated Fast Ethernet or Gigabit Ethernet interface.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><i>Understanding MAC Limiting</i></li> <li><i>Ethernet Interfaces Feature Guide for Routing Devices</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces (Aggregated Ethernet) on page 1513</a></p> <p><a href="#">show interfaces brief (Aggregated Ethernet) on page 1514</a></p> <p><a href="#">show interfaces detail (Aggregated Ethernet) on page 1514</a></p> <p><a href="#">show interfaces extensive (Aggregated Ethernet) on page 1515</a></p> <p><a href="#">show interfaces extensive (Aggregated Ethernet with VLAN Stacking) on page 1516</a></p>                                                                                                                                                       |
| <b>Output Fields</b>            | Table 89 on page 1508 lists the output fields for the <b>show interfaces</b> (Aggregated Ethernet) command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                         |

Table 89: Aggregated Ethernet show interfaces Output Fields

| Field Name         | Field Description                                          | Level of Output |
|--------------------|------------------------------------------------------------|-----------------|
| Physical Interface |                                                            |                 |
| Physical interface | Name of the physical interface and state of the interface. | All levels      |



Table 89: Aggregated Ethernet show interfaces Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                             | Level of Output              |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Enabled</b>                 | State of the physical interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .                                                                                                                                 | All levels                   |
| <b>Interface index</b>         | Index number of the physical interface, which reflects its initialization sequence.                                                                                                                                                                                           | All levels                   |
| <b>SNMP ifIndex</b>            | SNMP index number for the physical interface.                                                                                                                                                                                                                                 | <b>detail extensive</b> none |
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                             | <b>detail extensive</b>      |
| <b>Link-level type</b>         | Encapsulation being used on the physical interface.                                                                                                                                                                                                                           | All levels                   |
| <b>MTU</b>                     | Maximum transmission unit size on the physical interface.                                                                                                                                                                                                                     | All levels                   |
| <b>Speed</b>                   | Speed at which the interface is running.                                                                                                                                                                                                                                      | All levels                   |
| <b>Loopback</b>                | Loopback status: <b>Enabled</b> or <b>Disabled</b> . If loopback is enabled, type of loopback: <b>Local</b> or <b>Remote</b> .                                                                                                                                                | All levels                   |
| <b>Source filtering</b>        | Source filtering status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                                                  | All levels                   |
| <b>Flow control</b>            | Flow control status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                                                      | All levels                   |
| <b>Minimum links needed</b>    | Number of child links that must be operational for the aggregate interface to be operational.                                                                                                                                                                                 | All levels                   |
| <b>Device flags</b>            | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                                            | All levels                   |
| <b>Interface flags</b>         | Information about the interface. Possible values are described in the “Interfaces Flags” section under <i>Common Output Fields Description</i> .                                                                                                                              | All levels                   |
| <b>Current address</b>         | Configured MAC address.                                                                                                                                                                                                                                                       | <b>detail extensive</b>      |
| <b>Hardware address</b>        | Hardware MAC address.                                                                                                                                                                                                                                                         | <b>detail extensive</b>      |
| <b>Last flapped</b>            | Date, time, and how long ago the interface went from down to up or from up to down. The format is <b>Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> . | <b>detail extensive</b>      |
| <b>Input Rate</b>              | Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                                             | None specified               |
| <b>Output Rate</b>             | Output rate in bps and pps.                                                                                                                                                                                                                                                   | None specified               |
| <b>Statistics last cleared</b> | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                             | <b>detail extensive</b>      |

Table 89: Aggregated Ethernet show interfaces Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Level of Output         |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Traffic statistics</b> | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes and rate, in bps, at which bytes are received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes and rate, in bps, at which bytes are transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets and rate, in pps, at which packets are received on the interface.</li> <li>• <b>Output packets</b>—Number of packets and rate, in pps, at which packets are transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b> |
| <b>Input errors</b>       | <p>Input errors on the interface:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of incoming frame aborts and frame check sequence (FCS) errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's random early detection (RED) mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Giants</b>—Number of frames received that are larger than the giant threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or were not of interest. Usually, this field reports protocols that Junos OS does not handle.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul>                                                           | <b>detail extensive</b> |
| <b>Output errors</b>      | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b> —Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), then the cable, the far-end system, or the PIC is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>detail extensive</b> |

Table 89: Aggregated Ethernet show interfaces Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Level of Output       |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| IPv6 transit statistics  | <p>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | detail extensive      |
| Queue counters           | <p>CoS queue number and its associated user-configured forwarding class name.</p> <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul> <p><b>NOTE:</b> In DPCs that are not of the enhanced type, such as DPC 40x 1GE R, DPCE 20x 1GE + 2x 10GE R, or DPCE 40x 1GE R, you might notice a discrepancy in the output of the <b>show interfaces</b> command because incoming packets might be counted in the Egress queues section of the output. This problem occurs on non-enhanced DPCs because the egress queue statistics are polled from IMQ (Inbound Message Queuing) block of the I-chip. The IMQ block does not differentiate between ingress and egress WAN traffic; as a result, the combined statistics are displayed in the egress queue counters on the Routing Engine. In a simple VPLS scenario, if there is no MAC entry in DMAC table (by sending unidirectional traffic), traffic is flooded and the input traffic is accounted in IMQ. For bidirectional traffic (MAC entry in DMAC table), if the outgoing interface is on the same I-chip then both ingress and egress statistics are counted in a combined way. If the outgoing interface is on a different I-chip or FPC, then only egress statistics are accounted in IMQ. This behavior is expected with non-enhanced DPCs</p> | detail extensive      |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| Logical interface        | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All levels            |
| Index                    | Index number of the logical interface (which reflects its initialization sequence).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | detail extensive none |
| SNMP ifIndex             | SNMP interface index number of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | detail extensive none |
| Generation               | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | detail extensive      |
| Flags                    | Information about the logical interface. Possible values are described in the "Logical Interface Flags Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | All levels            |
| VLAN-Tag                 | Tag Protocol Identifier (TPID) and VLAN identifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All levels            |
| Demux                    | <p>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</p> <ul style="list-style-type: none"> <li>• <b>Source Family Inet</b></li> <li>• <b>Destination Family Inet</b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | detail extensive none |
| Encapsulation            | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All levels            |

Table 89: Aggregated Ethernet show interfaces Output Fields (*continued*)

| Field Name | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Level of Output              |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Statistics | <p>Information about the number of packets, packets per second, number of bytes, and bytes per second on this aggregate interface.</p> <ul style="list-style-type: none"> <li>• <b>Bundle</b>—Information about input and output bundle rates.</li> <li>• <b>Link</b>—(<b>detail</b> and <b>extensive</b> only) Information about specific links in the aggregate, including link state and input and output rates.</li> <li>• <b>Adaptive Statistics</b>—(<b>extensive</b> only) Information about adaptive load balancing counter statistics. <ul style="list-style-type: none"> <li>• <b>Adaptive Adjusts</b>—Number of times traffic flow imbalance was corrected by implementation of adaptive load balancing.</li> <li>• <b>Adaptive Scans</b>—Number of times the link utilization on each member link of the AE bundle was scanned by for adaptive load balancing</li> <li>• <b>Adaptive Tolerance</b>—Tolerance level, in percentage, for load imbalance on link utilization on each member link of the AE bundle.</li> <li>• <b>Adaptive Updates</b>—Number of times traffic flow loads have been updated on an AE bundle.</li> </ul> </li> <li>• <b>Marker Statistics</b>—(<b>detail</b> and <b>extensive</b> only) Information about 802.3ad marker protocol statistics on the specified links. <ul style="list-style-type: none"> <li>• <b>Marker Rx</b>—Number of valid marker protocol data units (PDUs) received on this aggregation port.</li> <li>• <b>Resp Tx</b>—Number of marker response PDUs transmitted on this aggregation port.</li> <li>• <b>Unknown Rx</b>—Number of frames received that either carry the slow protocols Ethernet type value (43B.4) but contain an unknown PDU, or are addressed to the slow protocols group MAC address (43B.3) but do not carry the slow protocols Ethernet type.</li> <li>• <b>Illegal Rx</b>—Number of frames received that carry the slow protocols Ethernet type value (43B.4) but contain a badly formed PDU or an illegal value of protocol subtype (43B.4).</li> </ul> </li> </ul> | <b>detail extensive</b> none |
| LACP info  | <p>Link Aggregation Control Protocol (LACP) information for each aggregated interface.</p> <ul style="list-style-type: none"> <li>• <b>Role</b> can be one of the following: <ul style="list-style-type: none"> <li>• <b>Actor</b>—Local device participating in LACP negotiation.</li> <li>• <b>Partner</b>—Remote device participating in LACP negotiation.</li> </ul> </li> <li>• <b>System priority</b>—Priority assigned to the system (by management or administrative policy), encoded as an unsigned integer.</li> <li>• <b>System identifier</b>—Actor or partner system ID, encoded as a MAC address.</li> <li>• <b>Port priority</b>—Priority assigned to the port by the actor or partner (by management or administrative policy), encoded as an unsigned integer.</li> <li>• <b>Unknown Rx</b>—Number of frames received that either carry the slow protocols Ethernet type value (43B.4) but contain an unknown protocol data unit (PDU), or are addressed to the slow protocols group MAC address (43B.3) but do not carry the slow protocols Ethernet type.</li> <li>• <b>Port key</b>—Operational key value assigned to the port by the actor or partner, encoded as an unsigned integer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |

Table 89: Aggregated Ethernet show interfaces Output Fields (*continued*)

| Field Name             | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level of Output       |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| LACP Statistics        | <p>LACP statistics for each aggregated interface.</p> <ul style="list-style-type: none"> <li>• <b>LACP Rx</b>—LACP received counter that increments for each normal hello.</li> <li>• <b>LACP Tx</b>—Number of LACP transmit packet errors logged.</li> <li>• <b>Unknown Rx</b>—Number of unrecognized packet errors logged.</li> <li>• <b>Illegal Rx</b>—Number of invalid packets received.</li> </ul> <p><b>NOTE:</b> For <b>LACP Rx</b> and <b>LACP Tx</b>, Packet count is updated only on snmp timer expiry (30 secs).</p> | detail extensive none |
| <i>protocol-family</i> | Protocol family configured on the logical interface. Possible values are described in the "Protocol Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                               | brief                 |
| Protocol               | Protocol family configured on the logical interface. Possible values are described in the "Protocol Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                               | detail extensive none |
| MTU                    | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | detail extensive none |
| Maximum labels         | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                  | detail extensive none |
| Generation             | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                | detail extensive      |
| Route Table            | Routing table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.                                                                                                                                                                                                                                                                                                                                                                                                              | detail extensive      |
| Flags                  | Information about protocol family flags. Possible values are described in the "Family Flags Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                       | detail extensive none |
| Mac-Validate Failures  | Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.                                                                                                                                                                                                                                                                                                                                                                       | detail extensive none |
| Addresses, Flags       | Information about address flags. Possible values are described in the "Addresses Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                  | detail extensive none |
| Destination            | IP address of the remote side of the connection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | detail extensive none |
| Local                  | IP address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | detail extensive none |
| Broadcast              | Broadcast address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | detail extensive none |
| Generation             | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                | detail extensive      |

## Sample Output

### show interfaces (Aggregated Ethernet)

```
user@host> show interfaces ae0
```

```

Physical interface: ae0, Enabled, Physical link is Up
Interface index: 153, SNMP ifIndex: 59
Link-level type: Ethernet, MTU: 1514, Speed: 300mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Disabled, Minimum links needed: 1
Device flags : Present Running
Interface flags: SNMP-Traps 16384
Current address: 00:05:85:8b:bf:f0, Hardware address: 00:05:85:8b:bf:f0
Last flapped : Never
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)

```

```

Logical interface ae0.0 (Index 72) (SNMP ifIndex 60)
Flags: SNMP-Traps 16384 Encapsulation: ENET2
Statistics
Bundle:
  Input :      0      0      0      0
  Output:      0      0      0      0
Protocol inet, MTU: 1500
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.100.1/24, Local: 10.100.1.2, Broadcast: 10.100.1.255

```

#### show interfaces brief (Aggregated Ethernet)

```

user@host> show interfaces ae0 brief
Physical interface: ae0, Enabled, Physical link is Up
Link-level type: Ethernet, MTU: 1514, Speed: 300mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Disabled
Device flags : Present Running
Interface flags: SNMP-Traps 16384

Logical interface ae0.0
Flags: SNMP-Traps 16384 Encapsulation: ENET2
inet 10.100.1.2/24

```

#### show interfaces detail (Aggregated Ethernet)

```

user@host> show interfaces ae0 detail
Physical interface: ae0, Enabled, Physical link is Up
Interface index: 153, SNMP ifIndex: 59, Generation: 36
Link-level type: Ethernet, MTU: 1514, Speed: 300mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Disabled, Minimum links needed: 1
Device flags : Present Running
Interface flags: SNMP-Traps 16384
Current address: 00:05:85:8b:bf:f0, Hardware address: 00:05:85:8b:bf:f0
Last flapped : Never
Statistics last cleared: Never
Traffic statistics:
Input bytes :      0      0 bps
Output bytes :      0      0 bps
Input packets:      0      0 pps
Output packets:      0      0 pps
Queue counters:      Queued packets  Transmitted packets  Dropped packets

0 best-effort      7375      7375      0
1 expedited-fo      0      0      0
2 assured-forw      0      0      0
3 network-cont     2268      2268      0

```

```

Logical interface ae0.0 (Index 72) (SNMP ifIndex 60) (Generation 18)
Flags: SNMP-Traps 16384 Encapsulation: ENET2
Statistics
Bundle:
  Input :      0      0      0      0
  Output:      0      0      0      0
Link:
  fe-0/1/0.0
    Input :      0      0      0      0
    Output:      0      0      0      0
  fe-0/1/2.0
    Input :      0      0      0      0
    Output:      0      0      0      0
  fe-0/1/3.0
    Input :      0      0      0      0
    Output:      0      0      0      0
Marker Statistics:  Marker Rx      Resp Tx      Unknown Rx      Illegal Rx
fe-0/1/0.0          0          0          0          0
fe-0/1/2.0          0          0          0          0
fe-0/1/3.0          0          0          0          0
Protocol inet, MTU: 1500, Generation: 37, Route table: 0
Flags: Is-Primary, Mac-Validate-Strict
Mac-Validate Failures: Packets: 0, Bytes: 0
  Destination: 10.100.1/24, Local: 10.100.1.2, Broadcast: 10.100.1.255,
  Generation: 49

```

#### show interfaces extensive (Aggregated Ethernet)

```

user@host> show interfaces ae0 extensive
Physical interface: ae0, Enabled, Physical link is Up
Interface index: 153, SNMP ifIndex: 59, Generation: 36
Link-level type: Ethernet, MTU: 1514, Speed: 300mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Disabled, Minimum links needed: 1
Device flags : Present Running
Interface flags: SNMP-Traps 16384
Current address: 00:05:85:8b:bf:f0, Hardware address: 00:05:85:8b:bf:f0
Last flapped : Never
Statistics last cleared: Never
Traffic statistics:
  Input bytes :      60      0 bps
  Output bytes :      0      0 bps
  Input packets:      1      0 pps
  Output packets:      0      0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0,
  Policed discards: 0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0,
  Resource errors: 0
Queue counters:      Queued packets      Transmitted packets      Dropped packets
0 best-effort          7375          7375          0
1 expedited-fo          0          0          0
2 assured-forw          0          0          0
3 network-cont        2268        2268          0

```

```

Logical interface ae0.0 (Index 72) (SNMP ifIndex 60) (Generation 18)
Flags: SNMP-Traps 16384 Encapsulation: ENET2
Statistics          Packets          pps          Bytes          bps
Bundle:
  Input :           1             0             60             0
  Output:           0             0              0             0
Adaptive Statistics:
  Adaptive Adjusts:           0
  Adaptive Scans  :           0
  Adaptive Updates:           0
Link:
  fe-0/1/0.0
    Input :           0             0              0             0
    Output:           0             0              0             0
  fe-0/1/2.0
    Input :           0             0              0             0
    Output:           0             0              0             0
  fe-0/1/3.0
    Input :           1             0             60             0
    Output:           0             0              0             0
LACP info:          Role      System          System      Port      Port      Port
                  priority          identifier  priority  number    key

  fe-1/0/3.0      Actor        127  00:24:dc:85:af:f0        127        2        1
  fe-1/0/3.0      Partner      127  00:23:9c:c3:1f:f0        127        1        1

LACP Statistics:      LACP Rx      LACP Tx      Unknown Rx      Illegal Rx
  fe-1/0/3.0          3188          3186           0           0
Marker Statistics:      Marker Rx      Resp Tx      Unknown Rx      Illegal Rx
  fe-0/1/0.0           0           0           0           0
  fe-0/1/2.0           0           0           0           0
  fe-0/1/3.0           0           0           0           0
Protocol inet, MTU: 1500, Generation: 37, Route table: 0
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 10.100.1/24, Local: 10.100.1.2, Broadcast: 10.100.1.255,
  Generation: 49

```

### show interfaces extensive (Aggregated Ethernet with VLAN Stacking)

```

user@host> show interfaces ae0 detail
Physical interface: ae0, Enabled, Physical link is Up
  Interface index: 155, SNMP ifIndex: 48, Generation: 186
  Link-level type: 52, MTU: 1518, Speed: 2000mbps, Loopback: Disabled, Source
  filtering: Disabled,
  Flow control: Disabled, Minimum links needed: 1, Minimum bandwidth needed: 0
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Current address: 00:12:1e:19:3f:f0, Hardware address: 00:12:1e:19:3f:f0
  Last flapped   : Never
  Statistics last cleared: Never
Traffic statistics:
  Input bytes :           2406875           40152 bps
  Output bytes :          1124470           22056 bps
  Input packets:           5307           5 pps
  Output packets:          13295          21 pps
IPv6 transit statistics:
  Input bytes :           0

```



```

Output bytes :          0
Input packets:          0
Output packets:         0
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
0, Resource errors: 0
Output errors:
Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0

```

```
Ingress queues: 4 supported, 4 in use
```

| Queue counters: | Queued packets | Transmitted packets | Dropped packets |
|-----------------|----------------|---------------------|-----------------|
| 0 best-effort   | 0              | 859777              | 0               |
| 1 expedited-fo  | 0              | 0                   | 0               |
| 2 assured-forw  | 0              | 0                   | 0               |
| 3 network-cont  | 0              | 0                   | 0               |

```
Egress queues: 4 supported, 4 in use
```

| Queue counters: | Queued packets | Transmitted packets | Dropped packets |
|-----------------|----------------|---------------------|-----------------|
| 0 best-effort   | 0              | 1897615             | 0               |
| 1 expedited-fo  | 0              | 0                   | 0               |
| 2 assured-forw  | 0              | 0                   | 0               |
| 3 network-cont  | 0              | 662505              | 0               |

```
Logical interface ae0.451 (Index 69) (SNMP ifIndex 167) (Generation 601)
```

```
Flags: SNMP-Traps VLAN-Tag [ 0x8100.451 ] Encapsulation: VLAN-VPLS
```

| Statistics | Packets | pps | Bytes  | bps  |
|------------|---------|-----|--------|------|
| Bundle:    |         |     |        |      |
| Input :    | 289     | 0   | 25685  | 376  |
| Output:    | 1698    | 4   | 130375 | 3096 |

```
Link:
```

```
ge-1/2/0.451
```

|         |     |   |       |     |
|---------|-----|---|-------|-----|
| Input : | 289 | 0 | 25685 | 376 |
| Output: | 0   | 0 | 0     | 0   |

```
ge-1/2/1.451
```

|         |      |   |        |      |
|---------|------|---|--------|------|
| Input : | 0    | 0 | 0      | 0    |
| Output: | 1698 | 4 | 130375 | 3096 |

| Marker Statistics: | Marker | Rx | Resp | Tx | Unknown | Rx | Illegal | Rx |
|--------------------|--------|----|------|----|---------|----|---------|----|
| ge-1/2/0.451       |        | 0  |      | 0  |         | 0  |         | 0  |
| ge-1/2/1.451       |        | 0  |      | 0  |         | 0  |         | 0  |

```
Protocol vpls, MTU: 1518, Generation: 849, Route table: 3
```

```
Flags: Is-Primary
```

```
Logical interface ae0.452 (Index 70) (SNMP ifIndex 170) (Generation 602)
```

```
Flags: SNMP-Traps VLAN-Tag [ 0x8100.452 ] Encapsulation: VLAN-VPLS
```

| Statistics | Packets | pps | Bytes  | bps  |
|------------|---------|-----|--------|------|
| Bundle:    |         |     |        |      |
| Input :    | 293     | 1   | 26003  | 1072 |
| Output:    | 1694    | 3   | 130057 | 2400 |

```
Link:
```

```
ge-1/2/0.452
```

|         |      |   |        |      |
|---------|------|---|--------|------|
| Input : | 293  | 1 | 26003  | 1072 |
| Output: | 1694 | 3 | 130057 | 2400 |

```
ge-1/2/1.452
  Input :          0          0          0          0
  Output:          0          0          0          0
Marker Statistics:  Marker Rx      Resp Tx      Unknown Rx      Illegal Rx
ge-1/2/0.452      0              0              0              0
ge-1/2/1.452      0              0              0              0
Protocol vpls, MTU: 1518, Generation: 850, Route table: 3
Flags: None
...
```

## show interfaces demux0 (Demux Interfaces)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces demux0.logical-interface-number &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index snmp-index&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | (MX Series and M Series routers only) Display status information about the specified demux interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | <p><b>none</b>—Display standard information about the specified demux interface.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index snmp-index</b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces demux0 (Demux) on page 1525</a></p> <p><a href="#">show interfaces demux0 (PPPoE over Aggregated Ethernet) on page 1526</a></p> <p><a href="#">show interfaces demux0 extensive (Targeted Distribution for Aggregated Ethernet Links) on page 1527</a></p> <p><a href="#">show interfaces demux0 (ACI Interface Set Configured) on page 1527</a></p>                                                                                                                                                                         |
| <b>Output Fields</b>            | Table 90 on page 1519 lists the output fields for the <b>show interfaces demux0</b> (Demux Interfaces) command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                     |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields

| Field Name         | Field Description               | Level of Output                |
|--------------------|---------------------------------|--------------------------------|
| Physical Interface |                                 |                                |
| Physical interface | Name of the physical interface. | brief detail extensive<br>none |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name        | Field Description                                                                                                                                  | Level of Output             |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Interface index   | Index number of the physical interface, which reflects its initialization sequence.                                                                | brief detail extensive none |
| Enabled           | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .               | brief detail extensive none |
| Physical link     | Status of the physical link ( <b>Up</b> or <b>Down</b> ).                                                                                          | detail extensive none       |
| Admin             | Administrative state of the interface ( <b>Up</b> or <b>Down</b> ).                                                                                | terse                       |
| Interface index   | Index number of the physical interface, which reflects its initialization sequence.                                                                | detail extensive none       |
| Link              | Status of the physical link ( <b>Up</b> or <b>Down</b> ).                                                                                          | terse                       |
| Targeting summary | Status of aggregated Ethernet links that are configured with targeted distribution ( <b>primary</b> or <b>backup</b> )                             | extensive                   |
| Bandwidth         | Bandwidth allocated to the aggregated Ethernet links that are configured with targeted distribution.                                               | extensive                   |
| Proto             | Protocol family configured on the interface.                                                                                                       | terse                       |
| SNMP ifIndex      | SNMP index number for the physical interface.                                                                                                      | detail extensive none       |
| Generation        | Unique number for use by Juniper Networks technical support only.                                                                                  | detail extensive            |
| Type              | Type of interface. <b>Software-Pseudo</b> indicates a standard software interface with no associated hardware device.                              | brief detail extensive none |
| Link-level type   | Encapsulation being used on the physical interface.                                                                                                | brief detail extensive      |
| MTU               | Maximum transmission unit size on the physical interface.                                                                                          | brief detail extensive      |
| Clocking          | Reference clock source: <b>Internal</b> (1) or <b>External</b> (2).                                                                                | brief detail extensive      |
| Speed             | Speed at which the interface is running.                                                                                                           | brief detail extensive      |
| Device flags      | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> . | brief detail extensive none |
| Interface flags   | Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .    | brief detail extensive none |
| Link type         | Data transmission type.                                                                                                                            | detail extensive none       |
| Link flags        | Information about the link. Possible values are described in the “Link Flags” section under <i>Common Output Fields Description</i> .              | detail extensive none       |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Level of Output       |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Physical info           | Information about the physical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | detail extensive      |
| Hold-times              | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | detail extensive      |
| Current address         | Configured MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | detail extensive      |
| Hardware address        | Hardware MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | detail extensive      |
| Alternate link address  | Backup address of the link.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | detail extensive      |
| Last flapped            | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | detail extensive none |
| Statistics last cleared | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | detail extensive      |
| Traffic statistics      | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> <li>• <b>IPv6 transit statistics</b>—Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</li> </ul> <p><b>NOTE:</b> These fields include dropped traffic and exception traffic, as those fields are not separately defined.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | detail extensive      |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output                    |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>Input errors</b>      | Input errors on the interface whose definitions are as follows: <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Giants</b>—Number of frames received that are larger than the giant packet threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul>                                                                 | <b>extensive</b>                   |
| <b>Input Rate</b>        | Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>none</b>                        |
| <b>Output errors</b>     | Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>                   |
| <b>Output Rate</b>       | Output rate in bps and pps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>none</b>                        |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                    |
| <b>Logical interface</b> | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>brief detail extensive none</b> |
| <b>Index</b>             | Index number of the logical interface, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>detail extensive none</b>       |
| <b>SNMP ifIndex</b>      | SNMP interface index number for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive none</b>       |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail</b>                      |
| <b>Flags</b>             | Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>brief detail extensive none</b> |
| <b>Encapsulation</b>     | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>brief extensive none</b>        |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name                       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Level of Output                       |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <b>ACI VLAN: Dynamic Profile</b> | Name of the dynamic profile that defines the agent circuit identifier (ACI) interface set. If configured, the ACI interface set enables the underlying demux interface to create dynamic VLAN subscriber interfaces based on ACI information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>brief detail extensive</b><br>none |
| <b>Demux</b>                     | Specific IP demultiplexing (demux) values: <ul style="list-style-type: none"> <li>• <b>Underlying interface</b>—The underlying interface that the demux interface uses.</li> <li>• <b>Index</b>—Index number of the logical interface.</li> <li>• <b>Family</b>—Protocol family configured on the logical interface.</li> <li>• <b>Source prefixes, total</b>—Total number of source prefixes for the underlying interface.</li> <li>• <b>Destination prefixes, total</b>—Total number of destination prefixes for the underlying interface.</li> <li>• <b>Prefix</b>—inet family prefix.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b> none          |
| <i>protocol-family</i>           | Protocol family configured on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>brief</b>                          |
| <b>Traffic statistics</b>        | Number and rate of bytes and packets received and transmitted on the specified interface set. <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the interface set.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the interface set.</li> <li>• <b>IPv6 transit statistics</b>—Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</li> </ul> <p><b>NOTE:</b> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | <b>detail extensive</b>               |
| <b>Local statistics</b>          | Number of transit bytes and packets received and transmitted on the local interface. <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b>               |

Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output                                   |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| <b>Transit statistics</b>      | <p>Number and rate of bytes and packets transiting the switch.</p> <p><b>NOTE:</b> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                        | <b>detail extensive</b>                           |
| <b>IPv6 Transit statistics</b> | <p>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</p> <p><b>NOTE:</b> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | <b>detail extensive</b>                           |
| <b>Input packets</b>           | Number of packets received on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | none                                              |
| <b>Output packets</b>          | Number of packets transmitted on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | none                                              |
| <b>Protocol</b>                | Protocol family. Possible values are described in the “Protocol Field” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b> none                      |
| <b>MTU</b>                     | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b> none                      |
| <b>Maximum labels</b>          | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive</b> none                      |
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive</b>                           |
| <b>Route table</b>             | Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive</b>                           |
| <b>Flags</b>                   | Information about protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b> none                      |
| <b>Mac-Validate Failures</b>   | Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive</b> none                      |
| <b>Addresses, Flags</b>        | Information about the address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b> none                      |
| <b>Destination</b>             | IP address of the remote side of the connection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b><br><b>statistics</b> none |



Table 90: show interfaces demux0 (Demux Interfaces) Output Fields (*continued*)

| Field Name                  | Field Description                                                                                                                                                                                                                                                                                    | Level of Output                       |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <b>Local</b>                | IP address of the logical interface.                                                                                                                                                                                                                                                                 | <b>detail extensive terse</b><br>none |
| <b>Remote</b>               | IP address of the remote interface.                                                                                                                                                                                                                                                                  | <b>terse</b>                          |
| <b>Broadcast</b>            | Broadcast address of the logical interlace.                                                                                                                                                                                                                                                          | <b>detail extensive none</b>          |
| <b>Generation</b>           | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                    | <b>detail extensive</b>               |
| <b>Link</b>                 | Name of the physical interfaces for member links in an aggregated Ethernet bundle for a PPPoE over aggregated Ethernet configuration. PPPoE traffic goes out on these interfaces.                                                                                                                    | <b>detail extensive none</b>          |
| <b>Dynamic-profile</b>      | Name of the PPPoE dynamic profile assigned to the underlying interface.                                                                                                                                                                                                                              | <b>detail extensive none</b>          |
| <b>Service Name Table</b>   | Name of the PPPoE service name table assigned to the PPPoE underlying interface.                                                                                                                                                                                                                     | <b>detail extensive none</b>          |
| <b>Max Sessions</b>         | Maximum number of dynamic PPPoE logical interfaces that the router can activate on the underlying interface.                                                                                                                                                                                         | <b>detail extensive none</b>          |
| <b>Duplicate Protection</b> | State of duplicate protection: <b>On</b> or <b>Off</b> . Duplicate protection prevents the activation of another dynamic PPPoE logical interface on the same underlying interface when a dynamic PPPoE logical interface for a client with the same MAC address is already active on that interface. | <b>detail extensive none</b>          |
| <b>Direct Connect</b>       | State of the configuration to ignore DSL Forum VSAs: <b>On</b> or <b>Off</b> . When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.                                                                                                 | <b>detail extensive none</b>          |
| <b>AC Name</b>              | Name of the access concentrator.                                                                                                                                                                                                                                                                     | <b>detail extensive none</b>          |

## Sample Output

### show interfaces demux0 (Demux)

```

user@host> show interfaces demux0
Physical interface: demux0, Enabled, Physical link is Up
Interface index: 128, SNMP ifIndex: 79, Generation: 129
Type: Software-Pseudo, Link-level type: Unspecified, MTU: 9192, Clocking: 1,
Speed: Unspecified
Device flags   : Present Running
Interface flags: Point-To-Point SNMP-Traps
Link type      : Full-Duplex
Link flags     : None
Physical info  : Unspecified
Hold-times    : Up 0 ms, Down 0 ms
Current address: Unspecified, Hardware address: Unspecified
Alternate link address: Unspecified
Last flapped   : Never
Statistics last cleared: Never

```

```

Traffic statistics:
Input bytes : 0 0 bps
Output bytes : 0 0 bps
Input packets: 0 0 pps
Output packets: 0 0 pps
IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0,
Policed discards: 0, Resource errors: 0
Output errors:
Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0,
Resource errors: 0

Logical interface demux0.0 (Index 87) (SNMP ifIndex 84) (Generation 312)
Flags: SNMP-Traps 0x4000 Encapsulation: ENET2
Demux:
Underlying interface: ge-2/0/1.0 (Index 74)
Family Inet Source prefixes, total 1
Prefix: 192.1.1/24
Traffic statistics:
Input bytes : 0
Output bytes : 1554
Input packets: 0
Output packets: 37
IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Local statistics:
Input bytes : 0
Output bytes : 1554
Input packets: 0
Output packets: 37
Transit statistics:
Input bytes : 0 0 bps
Output bytes : 0 0 bps
Input packets: 0 0 pps
Output packets: 0 0 pps
IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Protocol inet, MTU: 1500, Generation: 395, Route table: 0
Flags: Is-Primary, Mac-Validate-Strict
Mac-Validate Failures: Packets: 0, Bytes: 0
Addresses, Flags: Is-Preferred Is-Primary
Destination: 192.1.1/24, Local: 192.1.1.1, Broadcast: 192.1.1.255,
Generation: 434

```

#### show interfaces demux0 (PPPoE over Aggregated Ethernet)

```

user@host> show interfaces demux0.100
Logical interface demux0.100 (Index 76) (SNMP ifIndex 61160)
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.100 ]
Encapsulation: ENET2

```

```

Demux:
  Underlying interface: ae0 (Index 199)
Link:
  ge-1/0/0
  ge-1/1/0
Input packets : 0
Output packets: 0
Protocol pppoe
  Dynamic Profile: pppoe-profile,
  Service Name Table: service-table1,
  Max Sessions: 100, Duplicate Protection: On,
  Direct Connect: Off,
  AC Name: pppoe-server-1

```

### show interfaces demux0 extensive (Targeted Distribution for Aggregated Ethernet Links)

```
user@host> show interfaces demux0.1073741824 extensive
```

```

Logical interface demux0.1073741824 (Index 75) (SNMP ifIndex 558) (Generation 346)
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ] Encapsulation: ENET2
Demux:
  Underlying interface: ae0 (Index 201)
Link:
  ge-1/0/0
  ge-1/1/0
  ge-2/0/7
  ge-2/0/8
Targeting summary:
  ge-1/1/0, primary, Physical link is Up
  ge-2/0/8, backup, Physical link is Up
Bandwidth: 1000mbps

```

### show interfaces demux0 (ACI Interface Set Configured)

```

user@host> show interfaces demux0.1073741827
Logical interface demux0.1073741827 (Index 346) (SNMP ifIndex 527)
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1802 0x8100.302 ] Encapsulation: ENET2
Demux: Source Family Inet
ACI VLAN:
  Dynamic Profile: aci-vlan-set-profile
Demux:
  Underlying interface: ge-1/0/0 (Index 138)
Input packets : 18
Output packets: 16
Protocol inet, MTU: 1500
  Flags: Sendbcst-pkt-to-re, Unnumbered
  Donor interface: lo0.0 (Index 322)
  Preferred source address: 192.0.200.202
  Addresses, Flags: Primary Is-Default Is-Primary
    Local: 10.4.12.119
Protocol pppoe
  Dynamic Profile: aci-vlan-pppoe-profile,
  Service Name Table: None,
  Max Sessions: 32000, Max Sessions VSA Ignore: Off,
  Duplicate Protection: On, Short Cycle Protection: Off,
  Direct Connect: Off,
  AC Name: nbc

```

## show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port)

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                 | show interfaces diagnostics optics <i>interface-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>    | Command introduced before Junos OS Release 7.4.<br>Command introduced in Junos OS Release 12.1 for PTX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>            | Display diagnostics data, warnings, and alarms for Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, or Virtual Chassis Port interfaces.                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                | <i>interface-name</i> —Interface name. For example:<br><i>ge-fpc/pic/port</i><br><i>et-fpc/pic/port</i><br><i>et-fpc/pic/port:channel</i><br><i>xe-fpc/pic/port</i><br><i>vcp-fpc/pic/port</i>                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Additional Information</b> | <p>The transceivers are polled in 1-second intervals for diagnostics data, warnings, and alarms. The alarms do not cause the links to go down or the LEDs to change color, nor generate SNMP traps. Changes in alarm and warning status generate system log messages.</p> <p>Thresholds that trigger a high alarm, low alarm, high warning, or low warning are set by the transceiver vendors. Generally, a high alarm or low alarm indicates that the optics module is not operating properly. This information can be used to diagnose why a device is not working.</p> |



**NOTE:** Some transceivers do not support all optical diagnostics features described in the output fields.

If optics measures transmit or receive power as zero, then, the same is displayed as 0.000 mW / - Inf dBm

You can configure the P2-10G-40G-QSFPP PIC to operate either in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode. When the PIC is in 40-Gigabit Ethernet mode, you must execute the **show interfaces diagnostics optics et-fpc/pic/port** command. The output of this command displays the diagnostic optics information of the corresponding 40-Gigabit Ethernet port of the PIC. However, when the PIC is in 10-Gigabit Ethernet mode, you must execute the **show interfaces diagnostics optics et-fpc/pic/port:channel** command. The output of this command displays the diagnostic optics information of the corresponding 10-Gigabit Ethernet port of the PIC. For information about the P2-10G-40G-QSFPP PIC, see [“P2-10G-40G-QSFPP PIC Overview” on page 371](#).

**Required Privilege Level** view

**Related Documentation**

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

**List of Sample Output**

[show interfaces diagnostics optics \(DWDM and DWDM OTN\) on page 1544](#)  
[show interfaces diagnostics optics \(MPC6E with OTN MIC\) on page 1544](#)  
[show interfaces diagnostics optics \(Bidirectional SFP\) on page 1545](#)  
[show interfaces diagnostics optics \(SFP\) on page 1546](#)  
[show interfaces diagnostics optics \(SFP\) on page 1547](#)  
[show interfaces diagnostics optics \(XFP and CFP Optics\) on page 1548](#)  
[show interfaces diagnostics optics for 10-Gigabit Ethernet \(PTX 24-10GE-SFPP\) on page 1549](#)  
[show interfaces diagnostics optics for 40-Gigabit Ethernet on page 1549](#)  
[show interfaces diagnostics optics \(P1-PTX-24-10G-W-SFPP \) on page 1552](#)  
[show interfaces diagnostics optics \(P2-10G-40G-QSFPP PIC in 40-Gigabit Ethernet mode\) on page 1553](#)  
[show interfaces diagnostics optics \(P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet mode\) on page 1554](#)  
[show interfaces diagnostics optics \(P1-PTX-2-100G-WDM\) on page 1555](#)  
[show interfaces diagnostics optics \(MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC\) on page 1557](#)  
[show interfaces diagnostics optics \(PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC on page 1557](#)  
[show interfaces diagnostics optics for vcp on page 1559](#)

**Output Fields** [Table 91 on page 1529](#) lists the output fields for the **show interfaces diagnostics optics** command for DWDM and DWDM OTN PICs. Output fields are listed in the approximate order in which they appear.

**Table 91: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs**

| Field Name                            | Field Description                                                                                                                                                        |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical interface                    | Name of the physical interface.                                                                                                                                          |
| Laser bias current                    | Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents.               |
| Output power                          | Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm). This is a software equivalent to the <b>LsPOWMON</b> pin in hardware.                   |
| Receiver signal average optical power | Average received optical power, in mW and dBm. This indicator is a software equivalent to the <b>RxPOWMON</b> pin in hardware. Average optical power is vendor-specific. |
| Laser end-of-life alarm               | Laser end-of-life alarm: <b>On</b> or <b>Off</b> .                                                                                                                       |
| Laser wavelength alarm                | Laser wavelength alarm: <b>On</b> or <b>Off</b> .                                                                                                                        |

Table 91: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs (*continued*)

| Field Name                             | Field Description                                                                                                      |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Laser bias current alarm               | Laser bias current alarm: <b>On</b> or <b>Off</b> .                                                                    |
| Laser temperature alarm                | Laser temperature alarm: <b>On</b> or <b>Off</b> .                                                                     |
| Laser power alarm                      | Laser power alarm: <b>On</b> or <b>Off</b> .                                                                           |
| Modulator temperature alarm            | Modulator temperature alarm: <b>On</b> or <b>Off</b> .<br>Transceivers from some vendors do not support this field.    |
| Modulator bias alarm                   | Modulator bias alarm: <b>On</b> or <b>Off</b> .                                                                        |
| Tx multiplexer FIFO error alarm        | Transmit multiplexer first in, first out (FIFO) error alarm: <b>On</b> or <b>Off</b> .                                 |
| Tx loss of PLL lock alarm              | Transmit loss of phase-locked loop (PLL) lock alarm: <b>On</b> or <b>Off</b> .                                         |
| Rx loss of average optical power alarm | Receive loss of average optical power alarm: <b>On</b> or <b>Off</b> .                                                 |
| Rx loss of AC power alarm              | Receive loss of AC power alarm: <b>On</b> or <b>Off</b> .<br>Transceivers from some vendors do not support this field. |
| Rx loss of PLL lock alarm              | Receive loss of phase-locked loop (PLL) lock alarm: <b>On</b> or <b>Off</b> .                                          |

[Table 92 on page 1530](#) lists the output fields for the **show interfaces diagnostics optics** command when the router is operating with bidirectional SFP optics. Output fields are listed in the approximate order in which they appear.

Table 92: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics

| Field Name         | Field Description                                                                                                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical interface | Name of the physical interface.                                                                                                                            |
| Laser bias current | Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents. |
| Laser output power | Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm).                                                                           |
| Module temperature | Temperature of the optics module, in Celsius and Fahrenheit.                                                                                               |
| Module voltage     | Internally measured module voltage.                                                                                                                        |

Table 92: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics (*continued*)

| Field Name                            | Field Description                                                         |
|---------------------------------------|---------------------------------------------------------------------------|
| Receiver signal average optical power | Average received optical power, in mW and dBm.                            |
| Wavelength Channel number             | Wavelength channel number set in the optics module.                       |
| Wavelength setpoint                   | Wavelength set in the optics module.                                      |
| Tx Dither                             | Displays whether transmit dither is enabled or disabled.                  |
| Frequency Error                       | Frequency error reported from optics module.                              |
| Wavelength Error                      | Wavelength error reported from optics module.                             |
| Laser bias current high alarm         | Laser bias power setting high alarm. Displays <b>on</b> or <b>off</b> .   |
| Laser bias current low alarm          | Laser bias power setting low alarm. Displays <b>on</b> or <b>off</b> .    |
| Laser bias current high warning       | Laser bias power setting high warning. Displays <b>on</b> or <b>off</b> . |
| Laser bias current low warning        | Laser bias power setting low warning. Displays <b>on</b> or <b>off</b> .  |
| Tx power high alarm                   | Laser output power high alarm. Displays <b>on</b> or <b>off</b> .         |
| Tx power low alarm                    | Laser output power low alarm. Displays <b>on</b> or <b>off</b> .          |
| Tx power high warning                 | Laser output power high warning. Displays <b>on</b> or <b>off</b> .       |
| Tx power low warning                  | Laser output power low warning. Displays <b>on</b> or <b>off</b> .        |
| Module temperature high alarm         | Module temperature high alarm. Displays <b>on</b> or <b>off</b> .         |
| Module temperature low alarm          | Module temperature low alarm. Displays <b>on</b> or <b>off</b> .          |
| Module temperature high warning       | Module temperature high warning. Displays <b>on</b> or <b>off</b> .       |
| Module temperature low warning        | Module temperature low warning. Displays <b>on</b> or <b>off</b> .        |
| Module voltage high alarm             | Module voltage high alarm. Displays <b>on</b> or <b>off</b> .             |

Table 92: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics (*continued*)

| Field Name                                | Field Description                                                                                          |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Module voltage low alarm                  | Module voltage low alarm. Displays <b>on</b> or <b>off</b> .                                               |
| Module voltage high warning               | Module voltage high warning. Displays <b>on</b> or <b>off</b> .                                            |
| Module voltage low warning                | Module voltage high warning. Displays <b>on</b> or <b>off</b> .                                            |
| Laser rx power high alarm                 | Receive laser power high alarm. Displays <b>on</b> or <b>off</b> .                                         |
| Laser rx power low alarm                  | Receive laser power low alarm. Displays <b>on</b> or <b>off</b> .                                          |
| Laser rx power high warning               | Receive laser power high warning. Displays <b>on</b> or <b>off</b> .                                       |
| Laser rx power low warning                | Receive laser power low warning. Displays <b>on</b> or <b>off</b> .                                        |
| TEC fault alarm                           | Displays whether the TEC fault alarm is <b>on</b> or <b>off</b> .                                          |
| Wavelength unlocked alarm                 | Displays whether the wavelength unlocked alarm is <b>on</b> or <b>off</b> .                                |
| TxTune                                    | Display whether the optical transmit side is not ready due to tuning.                                      |
| Laser bias current high alarm threshold   | Vendor-specified threshold for the laser bias current high alarm: <b>70.000 mA</b> .                       |
| Laser bias current low alarm threshold    | Vendor-specified threshold for the laser bias current low alarm: <b>0.0002 mA</b> .                        |
| Laser bias current high warning threshold | Vendor-specified threshold for the laser bias current high warning: <b>65.000 mA</b> .                     |
| Laser bias current low warning threshold  | Vendor-specified threshold for the laser bias current low warning: <b>0.0002 mA</b> .                      |
| Rx power high alarm threshold             | Vendor-specified threshold for the laser output power high alarm: <b>1.0000 mW</b> or <b>0.00 dBm</b> .    |
| Rx power low alarm threshold              | Vendor-specified threshold for the laser output power low alarm: <b>0.0560 mW</b> or <b>-12.52 dBm</b> .   |
| Rx power high warning threshold           | Vendor-specified threshold for the laser output power high warning: <b>0.6300 mW</b> or <b>-2.01 dBm</b> . |



**Table 92: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics** *(continued)*

| Field Name                                       | Field Description                                                                                          |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Rx power low warning threshold</b>            | Vendor-specified threshold for the laser output power low warning: <b>0.0890 mW</b> or <b>-10.51 dBm</b> . |
| <b>Module temperature high alarm threshold</b>   | Vendor-specified threshold for the module temperature high alarm: <b>100° C</b> or <b>212° F</b> .         |
| <b>Module temperature low alarm threshold</b>    | Vendor-specified threshold for the module temperature low alarm: <b>-50° C</b> or <b>-58° F</b> .          |
| <b>Module temperature high warning threshold</b> | Vendor-specified threshold for the module temperature high warning: <b>95° C</b> or <b>203° F</b> .        |
| <b>Module temperature low warning threshold</b>  | Vendor-specified threshold for the module temperature low warning: <b>-48° C</b> or <b>-54° F</b> .        |
| <b>Module voltage high alarm threshold</b>       | Module voltage high alarm threshold: <b>3.700 v</b> .                                                      |
| <b>Module voltage low alarm threshold</b>        | Module voltage low alarm threshold: <b>2.900 v</b> .                                                       |
| <b>Module voltage high warning threshold</b>     | Module voltage high warning threshold: <b>3.7600 v</b> .                                                   |
| <b>Module voltage low warning threshold</b>      | Module voltage low warning threshold: <b>3.000 v</b> .                                                     |
| <b>Laser rx power high alarm threshold</b>       | Vendor-specified threshold for the laser Rx power high alarm: <b>1.9953 mW</b> or <b>3.00 dBm</b> .        |
| <b>Laser rx power low alarm threshold</b>        | Vendor-specified threshold for the laser Rx power low alarm: <b>0.0001 mW</b> or <b>-40.00 dBm</b> .       |
| <b>Laser rx power high warning threshold</b>     | Vendor-specified threshold for the laser Rx power high warning: <b>1.0000 mW</b> or <b>0.00 dBm</b> .      |
| <b>Laser rx power low warning threshold</b>      | Vendor-specified threshold for the laser Rx power low warning: <b>0.0010 mW</b> or <b>-30.00 dBm</b> .     |

[Table 93 on page 1533](#) lists the output fields for the **show interfaces diagnostics optics** command for SFP transceivers. Output fields are listed in the approximate order in which they appear.

**Table 93: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers**

| Field Name                | Field Description               |
|---------------------------|---------------------------------|
| <b>Physical interface</b> | Name of the physical interface. |

Table 93: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers (*continued*)

| Field Name                      | Field Description                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------|
| Laser bias current              | Measured laser bias current in uA.                                                             |
| Laser output power              | Measured laser output power in mW.                                                             |
| Module temperature              | Internally measured module temperature.                                                        |
| Module voltage                  | Internally measured module voltage.                                                            |
| Laser rx power                  | Measured receive optical power in mW.                                                          |
| Laser bias current high alarm   | Laser bias current high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.     |
| Laser bias current low alarm    | Laser bias current low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.      |
| Laser output power high alarm   | Laser output power high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.     |
| Laser output power low alarm    | Laser output power low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.      |
| Module temp high alarm          | Module temperature high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.     |
| Module temp low alarm           | Module temperature low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.      |
| Laser rx power high alarm       | Laser receive power high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.    |
| Laser rx power low alarm        | Laser receive power low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.     |
| Laser bias current high warning | Laser bias current high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific. |
| Laser bias current low warning  | Laser bias current low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Laser output power high warning | Laser output power high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific. |
| Laser output power low warning  | Laser output power low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Module temperature high warning | Module temperature high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific. |

**Table 93: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers (*continued*)**

| Field Name                                | Field Description                                                                               |
|-------------------------------------------|-------------------------------------------------------------------------------------------------|
| Module temperature low warning            | Module temperature low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.   |
| Laser rx power high warning               | Laser receive power high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific. |
| Laser rx power low warning                | Laser receive power low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Laser bias current high alarm threshold   | Laser bias current high alarm threshold. Alarm threshold ranges are vendor-specific.            |
| Laser bias current low alarm threshold    | Laser bias current low alarm threshold. Alarm threshold ranges are vendor-specific.             |
| Laser bias current high warning threshold | Laser bias current high warning threshold. Warning ranges are vendor-specific.                  |
| Laser bias current low warning threshold  | Laser bias current low warning threshold. Warning ranges are vendor-specific.                   |
| Laser output power high alarm threshold   | Laser output power high alarm threshold. Alarm threshold ranges are vendor-specific.            |
| Laser output power low alarm threshold    | Laser output power low alarm threshold. Alarm threshold ranges are vendor-specific.             |
| Laser output power high warning threshold | Laser output power high warning threshold. Warning ranges are vendor-specific.                  |
| Laser output power low warning threshold  | Laser output power low warning threshold. Warning ranges are vendor-specific.                   |
| Module temperature high alarm threshold   | Module temperature high alarm threshold. Alarm threshold ranges are vendor-specific.            |
| Module temperature low alarm threshold    | Module temperature low alarm threshold. Alarm threshold ranges are vendor-specific.             |
| Module temperature high warning threshold | Module temperature high warning threshold. Warning ranges are vendor-specific.                  |
| Module temperature low warning threshold  | Module temperature low warning threshold. Warning ranges are vendor-specific.                   |
| Module voltage high alarm threshold       | Module voltage high alarm threshold. Alarm ranges are vendor-specific.                          |

**Table 93: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers (*continued*)**

| Field Name                            | Field Description                                                                         |
|---------------------------------------|-------------------------------------------------------------------------------------------|
| Module voltage low alarm threshold    | Module voltage low alarm threshold. Alarm ranges are vendor-specific.                     |
| Module voltage high warning threshold | Module voltage high warning threshold. Warning ranges are vendor-specific.                |
| Module voltage low warning threshold  | Module voltage low warning threshold. Warning ranges are vendor-specific.                 |
| Laser rx power high alarm threshold   | Laser receive power high alarm threshold. Alarm threshold ranges are vendor-specific.     |
| Laser rx power low alarm threshold    | Laser receive power low alarm threshold. Alarm threshold ranges are vendor-specific.      |
| Laser rx power high warning threshold | Laser receive power high warning threshold. Warning threshold ranges are vendor-specific. |
| Laser rx power high low threshold     | Laser receive power high warning threshold. Warning threshold ranges are vendor-specific. |

[Table 94 on page 1536](#) lists the output fields for the **show interfaces diagnostics optics** command for 10-Gigabit Ethernet transceivers. Output fields are listed in the approximate order in which they appear.

**Table 94: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers**

| Field Name                    | Field Description                                                                          |
|-------------------------------|--------------------------------------------------------------------------------------------|
| Physical interface            | Name of the physical interface.                                                            |
| Laser bias current            | Measured laser bias current in mA.                                                         |
| Laser output power            | Measured laser output power in mW.                                                         |
| Module temperature            | Internally measured module temperature.                                                    |
| Laser rx power                | Measured receive optical power in mW.                                                      |
| Laser bias current high alarm | Laser bias current high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific. |
| Laser bias current low alarm  | Laser bias current low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.  |
| Laser output power high alarm | Laser output power high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific. |

**Table 94: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers (*continued*)**

| Field Name                              | Field Description                                                                               |
|-----------------------------------------|-------------------------------------------------------------------------------------------------|
| Laser output power low alarm            | Laser output power low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.       |
| Module temp high alarm                  | Module temperature high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.      |
| Module temp low alarm                   | Module temperature low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.       |
| Laser rx power high alarm               | Laser receive power high alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.     |
| Laser rx power low alarm                | Laser receive power low alarm: <b>On</b> or <b>Off</b> . Alarm ranges are vendor-specific.      |
| Laser bias current high warning         | Laser bias current high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Laser bias current low warning          | Laser bias current low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.   |
| Laser output power high warning         | Laser output power high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Laser output power low warning          | Laser output power low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.   |
| Module temperature high warning         | Module temperature high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Module temperature low warning          | Module temperature low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.   |
| Laser rx power high warning             | Laser receive power high warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific. |
| Laser rx power low warning              | Laser receive power low warning: <b>On</b> or <b>Off</b> . Warning ranges are vendor-specific.  |
| Laser bias current high alarm threshold | Laser bias current high alarm threshold. Alarm threshold ranges are vendor-specific.            |
| Laser bias current low alarm threshold  | Laser bias current low alarm threshold. Alarm threshold ranges are vendor-specific.             |
| Laser output power high alarm threshold | Laser output power high alarm threshold. Alarm threshold ranges are vendor-specific.            |

Table 94: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers (*continued*)

| Field Name                                | Field Description                                                                         |
|-------------------------------------------|-------------------------------------------------------------------------------------------|
| Laser output power low alarm threshold    | Laser output power low alarm threshold. Alarm threshold ranges are vendor-specific.       |
| Module temperature high alarm threshold   | Module temperature high alarm threshold. Alarm threshold ranges are vendor-specific.      |
| Module temperature low alarm threshold    | Module temperature low alarm threshold. Alarm threshold ranges are vendor-specific.       |
| Laser rx power high alarm threshold       | Laser receive power high alarm threshold. Alarm threshold ranges are vendor-specific.     |
| Laser rx power low alarm threshold        | Laser receive power low alarm threshold. Alarm threshold ranges are vendor-specific.      |
| Laser bias current high warning threshold | Laser bias current high warning threshold. Warning ranges are vendor-specific.            |
| Laser bias current low warning threshold  | Laser bias current low warning threshold. Warning ranges are vendor-specific.             |
| Laser output power high warning threshold | Laser output power high warning threshold. Warning ranges are vendor-specific.            |
| Laser output power low warning threshold  | Laser output power low warning threshold. Warning ranges are vendor-specific.             |
| Module temperature high warning threshold | Module temperature high warning threshold. Warning ranges are vendor-specific.            |
| Module temperature low warning threshold  | Module temperature low warning threshold. Warning ranges are vendor-specific.             |
| Laser rx power high warning threshold     | Laser receive power high warning threshold. Warning threshold ranges are vendor-specific. |
| Laser rx power low warning threshold      | Laser receive power low warning threshold. Warning threshold ranges are vendor-specific.  |

[Table 95 on page 1539](#) lists the output fields for the **show interfaces diagnostics optics** command for XFP transceivers. Output fields are listed in the approximate order in which they appear.

**Table 95: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers**

| Field Name                             | Field Description                                                                                                                                          |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Physical interface</b>              | Name of the physical interface.                                                                                                                            |
| <b>Laser bias current</b>              | Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents. |
| <b>Laser output power</b>              | Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm). This is a software equivalent to the <b>LsPOWMON</b> pin in hardware.     |
| <b>Module temperature</b>              | Temperature of the XFP optics module, in Celsius and Fahrenheit.                                                                                           |
| <b>Laser rx power</b>                  | Laser received optical power, in mW and dBm.                                                                                                               |
| <b>Laser bias current high alarm</b>   | Laser bias power setting high alarm. Displays <b>on</b> or <b>off</b> .                                                                                    |
| <b>Laser bias current low alarm</b>    | Laser bias power setting low alarm. Displays <b>on</b> or <b>off</b> .                                                                                     |
| <b>Laser bias current high warning</b> | Laser bias power setting high warning. Displays <b>on</b> or <b>off</b> .                                                                                  |
| <b>Laser bias current low warning</b>  | Laser bias power setting low warning. Displays <b>on</b> or <b>off</b> .                                                                                   |
| <b>Laser output power high alarm</b>   | Laser output power high alarm. Displays <b>on</b> or <b>off</b> .                                                                                          |
| <b>Laser output power low alarm</b>    | Laser output power low alarm. Displays <b>on</b> or <b>off</b> .                                                                                           |
| <b>Laser output power high warning</b> | Laser output power high warning. Displays <b>on</b> or <b>off</b> .                                                                                        |
| <b>Laser output power low warning</b>  | Laser output power low warning. Displays <b>on</b> or <b>off</b> .                                                                                         |
| <b>Module temperature high alarm</b>   | Module temperature high alarm. Displays <b>on</b> or <b>off</b> .                                                                                          |
| <b>Module temperature low alarm</b>    | Module temperature low alarm. Displays <b>on</b> or <b>off</b> .                                                                                           |
| <b>Module temperature high warning</b> | Module temperature high warning. Displays <b>on</b> or <b>off</b> .                                                                                        |
| <b>Module temperature low warning</b>  | Module temperature low warning. Displays <b>on</b> or <b>off</b> .                                                                                         |

Table 95: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers (*continued*)

| Field Name                                | Field Description                                                                                                                           |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Laser rx power high alarm                 | Receive laser power high alarm. Displays <b>on</b> or <b>off</b> .                                                                          |
| Laser rx power low alarm                  | Receive laser power low alarm. Displays <b>on</b> or <b>off</b> .                                                                           |
| Laser rx power high warning               | Receive laser power high warning. Displays <b>on</b> or <b>off</b> .                                                                        |
| Laser rx power low warning                | Receive laser power low warning. Displays <b>on</b> or <b>off</b> .                                                                         |
| Module not ready alarm                    | Module not ready alarm. When <b>on</b> , indicates the module has an operational fault. Displays <b>on</b> or <b>off</b> .                  |
| Module power down alarm                   | Module power down alarm. When <b>on</b> , module is in a limited power mode, low for normal operation. Displays <b>on</b> or <b>off</b> .   |
| Tx data not ready alarm                   | Any condition leading to invalid data on the transmit path. Displays <b>on</b> or <b>off</b> .                                              |
| Tx not ready alarm                        | Any condition leading to invalid data on the transmit path. Displays <b>on</b> or <b>off</b> .                                              |
| Tx laser fault alarm                      | Laser fault condition. Displays <b>on</b> or <b>off</b> .                                                                                   |
| Tx CDR loss of lock alarm                 | Transmit clock and data recovery (CDR) loss of lock. Loss of lock on the transmit side of the CDR. Displays <b>on</b> or <b>off</b> .       |
| Rx not ready alarm                        | Any condition leading to invalid data on the receive path. Displays <b>on</b> or <b>off</b> .                                               |
| Rx loss of signal alarm                   | Receive Loss of Signal alarm. When <b>on</b> , indicates insufficient optical input power to the module. Displays <b>on</b> or <b>off</b> . |
| Rx CDR loss of lock alarm                 | Receive CDR loss of lock. Loss of lock on the receive side of the CDR. Displays <b>on</b> or <b>off</b> .                                   |
| Laser bias current high alarm threshold   | Vendor-specified threshold for the laser bias current high alarm: <b>130.000 mA</b> .                                                       |
| Laser bias current low alarm threshold    | Vendor-specified threshold for the laser bias current low alarm: <b>10.000 mA</b> .                                                         |
| Laser bias current high warning threshold | Vendor-specified threshold for the laser bias current high warning: <b>120.000 mA</b> .                                                     |
| Laser bias current low warning threshold  | Vendor-specified threshold for the laser bias current low warning: <b>12.000 mA</b> .                                                       |
| Laser output power high alarm threshold   | Vendor-specified threshold for the laser output power high alarm: <b>0.8910 mW</b> or <b>-0.50 dBm</b> .                                    |



**Table 95: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers (continued)**

| Field Name                                | Field Description                                                                          |
|-------------------------------------------|--------------------------------------------------------------------------------------------|
| Laser output power low alarm threshold    | Vendor-specified threshold for the laser output power low alarm: 0.2230 mW or -6.52 dBm.   |
| Laser output power high warning threshold | Vendor-specified threshold for the laser output power high warning: 0.7940 mW or -100 dBm. |
| Laser output power low warning threshold  | Vendor-specified threshold for the laser output power low warning: 0.2510 mW or -600 dBm.  |
| Module temperature high alarm threshold   | Vendor-specified threshold for the module temperature high alarm: 90° C or 194° F.         |
| Module temperature low alarm threshold    | Vendor-specified threshold for the module temperature low alarm: -5° C or 23° F.           |
| Module temperature high warning threshold | Vendor-specified threshold for the module temperature high warning: 85 ° C or 185 ° F.     |
| Module temperature low warning threshold  | Vendor-specified threshold for the module temperature low warning: 0° C or 32° F.          |
| Laser rx power high alarm threshold       | Vendor-specified threshold for the laser Rx power high alarm: 1.2589 mW or 1.00 dBm.       |
| Laser rx power low alarm threshold        | Vendor-specified threshold for the laser Rx power low alarm: 0.0323 mW or -14.91 dBm.      |
| Laser rx power high warning threshold     | Vendor-specified threshold for the laser Rx power high warning: 1.1220 mW or 0.50 dBm.     |
| Laser rx power low warning threshold      | Vendor-specified threshold for the laser Rx power low warning: 0.0363 mW or -14.40 dBm.    |

[Table 96 on page 1541](#) lists the output fields for the **show interfaces diagnostics optics** command for VCP. Output fields are listed in the approximate order in which they appear.

**Table 96: show interfaces diagnostics optics Output for Virtual Chassis Ports**

| Field Name         | Field Description                                                                                                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical interface | Name of the physical interface.                                                                                                                            |
| Laser bias current | Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents. |
| Laser output power | Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm).                                                                           |
| Module temperature | Temperature of the optics module, in Celsius and Fahrenheit.                                                                                               |

Table 96: show interfaces diagnostics optics Output for Virtual Chassis Ports (*continued*)

| Field Name                            | Field Description                                                         |
|---------------------------------------|---------------------------------------------------------------------------|
| Module voltage                        | Internally measured module voltage.                                       |
| Receiver signal average optical power | Average received optical power, in mW and dBm.                            |
| Laser bias current high alarm         | Laser bias power setting high alarm. Displays <b>on</b> or <b>off</b> .   |
| Laser bias current low alarm          | Laser bias power setting low alarm. Displays <b>on</b> or <b>off</b> .    |
| Laser bias current high warning       | Laser bias power setting high warning. Displays <b>on</b> or <b>off</b> . |
| Laser bias current low warning        | Laser bias power setting low warning. Displays <b>on</b> or <b>off</b> .  |
| Laser output power high alarm         | Laser output power high alarm. Displays <b>on</b> or <b>off</b> .         |
| Laser output power low alarm          | Laser output power low alarm. Displays <b>on</b> or <b>off</b> .          |
| Laser output power high warning       | Laser output power high warning. Displays <b>on</b> or <b>off</b> .       |
| Laser output power low warning        | Laser output power low warning. Displays <b>on</b> or <b>off</b> .        |
| Module temperature high alarm         | Module temperature high alarm. Displays <b>on</b> or <b>off</b> .         |
| Module temperature low alarm          | Module temperature low alarm. Displays <b>on</b> or <b>off</b> .          |
| Module temperature high warning       | Module temperature high warning. Displays <b>on</b> or <b>off</b> .       |
| Module temperature low warning        | Module temperature low warning. Displays <b>on</b> or <b>off</b> .        |
| Module voltage high alarm             | Module voltage high alarm. Displays <b>on</b> or <b>off</b> .             |
| Module voltage low alarm              | Module voltage low alarm. Displays <b>on</b> or <b>off</b> .              |
| Module voltage high warning           | Module voltage high warning. Displays <b>on</b> or <b>off</b> .           |

Table 96: show interfaces diagnostics optics Output for Virtual Chassis Ports (*continued*)

| Field Name                                | Field Description                                                    |
|-------------------------------------------|----------------------------------------------------------------------|
| Module voltage low warning                | Module voltage high warning. Displays <b>on</b> or <b>off</b> .      |
| Laser rx power high alarm                 | Receive laser power high alarm. Displays <b>on</b> or <b>off</b> .   |
| Laser rx power low alarm                  | Receive laser power low alarm. Displays <b>on</b> or <b>off</b> .    |
| Laser rx power high warning               | Receive laser power high warning. Displays <b>on</b> or <b>off</b> . |
| Laser rx power low warning                | Receive laser power low warning. Displays <b>on</b> or <b>off</b> .  |
| Laser bias current high alarm threshold   | Vendor-specified threshold for the laser bias current high alarm.    |
| Laser bias current low alarm threshold    | Vendor-specified threshold for the laser bias current low alarm.     |
| Laser bias current high warning threshold | Vendor-specified threshold for the laser bias current high warning.  |
| Laser bias current low warning threshold  | Vendor-specified threshold for the laser bias current low warning.   |
| Laser output power high alarm threshold   | Vendor-specified threshold for the laser output power high alarm.    |
| Laser output power low alarm threshold    | Vendor-specified threshold for the laser output power low alarm.     |
| Laser output power high warning threshold | Vendor-specified threshold for the laser output power high warning.  |
| Laser output power low warning threshold  | Vendor-specified threshold for the laser output power low warning.   |
| Module temperature high alarm threshold   | Vendor-specified threshold for the module temperature high alarm.    |
| Module temperature low alarm threshold    | Vendor-specified threshold for the module temperature low alarm.     |
| Module temperature high warning threshold | Vendor-specified threshold for the module temperature high warning.  |

Table 96: show interfaces diagnostics optics Output for Virtual Chassis Ports (*continued*)

| Field Name                               | Field Description                                                  |
|------------------------------------------|--------------------------------------------------------------------|
| Module temperature low warning threshold | Vendor-specified threshold for the module temperature low warning. |
| Module voltage high alarm threshold      | Module voltage high alarm threshold.                               |
| Module voltage low alarm threshold       | Module voltage low alarm threshold.                                |
| Module voltage high warning threshold    | Module voltage high warning threshold.                             |
| Module voltage low warning threshold     | Module voltage low warning threshold.                              |
| Laser rx power high alarm threshold      | Vendor-specified threshold for the laser Rx power high alarm.      |
| Laser rx power low alarm threshold       | Vendor-specified threshold for the laser Rx power low alarm.       |
| Laser rx power high warning threshold    | Vendor-specified threshold for the laser Rx power high warning.    |
| Laser rx power low warning threshold     | Vendor-specified threshold for the laser Rx power low warning.     |

## Sample Output

### show interfaces diagnostics optics (DWDM and DWDM OTN)

```

user@host> show interfaces diagnostics optics ge-5/0/0
Physical interface: ge-5/0/0
  Laser bias current           : 79.938 mA
  Laser output power          : 1.592 mW / 2.02 dBm
  Receiver signal average optical power : 1.3854 mW / 1.42 dBm
  Laser end-of-life alarm      : Off
  Laser wavelength alarm       : Off
  Laser bias current alarm     : Off
  Laser temperature alarm      : Off
  Laser power alarm            : Off
  Modulator temperature alarm   : Off
  Modulator bias alarm         : Off
  Tx multiplexer FIFO error alarm : Off
  Tx loss of PLL lock alarm    : Off
  Rx loss of average optical power alarm: Off
  Rx loss of AC power alarm    : Off
  Rx loss of PLL lock alarm    : Off

```

### show interfaces diagnostics optics (MPC6E with OTN MIC)

```

user@host> show interfaces diagnostics optics xe-3/0/0

```

```

Physical interface: xe-3/0/0
Laser bias current           : 7.806 mA
Laser output power          : 0.5660 mW / -2.47 dBm
Module temperature          : 32 degrees C / 89 degrees F
Module voltage              : 3.3560 V
Receiver signal average optical power : 0.5501 mW / -2.60 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser output power high alarm : Off
Laser output power low alarm  : Off
Laser output power high warning : Off
Laser output power low warning : Off
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Module voltage high warning   : Off
Module voltage low warning    : Off
Laser rx power high alarm     : Off
Laser rx power low alarm      : Off
Laser rx power high warning   : Off
Laser rx power low warning    : Off
Laser bias current high alarm threshold : 11.800 mA
Laser bias current low alarm threshold  : 4.000 mA
Laser bias current high warning threshold : 10.800 mA
Laser bias current low warning threshold : 5.000 mA
Laser output power high alarm threshold : 0.8310 mW / -0.80 dBm
Laser output power low alarm threshold  : 0.2510 mW / -6.00 dBm
Laser output power high warning threshold : 0.6600 mW / -1.80 dBm
Laser output power low warning threshold : 0.3160 mW / -5.00 dBm
Module temperature high alarm threshold : 78 degrees C / 172 degrees F
Module temperature low alarm threshold  : -13 degrees C / 9 degrees F
Module temperature high warning threshold : 73 degrees C / 163 degrees F
Module temperature low warning threshold : -8 degrees C / 18 degrees F
Module voltage high alarm threshold     : 3.700 V
Module voltage low alarm threshold      : 2.900 V
Module voltage high warning threshold   : 3.600 V
Module voltage low warning threshold    : 3.000 V
Laser rx power high alarm threshold     : 1.0000 mW / 0.00 dBm
Laser rx power low alarm threshold      : 0.0100 mW / -20.00 dBm
Laser rx power high warning threshold   : 0.7943 mW / -1.00 dBm
Laser rx power low warning threshold    : 0.0158 mW / -18.01 dBm

```

#### show interfaces diagnostics optics (Bidirectional SFP)

```

user@host> show interfaces diagnostics optics ge-3/0/6
Physical interface: ge-3/0/6
Laser bias current           : 13.356 mA
Laser output power          : 0.2210 mW / -6.56 dBm
Module temperature          : 36 degrees C / 96 degrees F
Module voltage              : 3.2180 V
Receiver signal average optical power : 0.2429 mW / -6.15 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser bias current high warning : Off
Laser bias current low warning : Off

```

```

Laser output power high alarm           : Off
Laser output power low alarm            : Off
Laser output power high warning         : Off
Laser output power low warning          : Off
Module temperature high alarm           : Off
Module temperature low alarm            : Off
Module temperature high warning         : Off
Module temperature low warning          : Off
Module voltage high alarm               : Off
Module voltage low alarm                : Off
Module voltage high warning             : Off
Module voltage low warning              : Off
Laser rx power high alarm               : Off
Laser rx power low alarm                : Off
Laser rx power high warning             : Off
Laser rx power low warning              : Off
Laser bias current high alarm threshold : 70.000 mA
Laser bias current low alarm threshold  : 0.002 mA
Laser bias current high warning threshold : 65.000 mA
Laser bias current low warning threshold : 0.002 mA
Laser output power high alarm threshold : 1.0000 mW / 0.00 dBm
Laser output power low alarm threshold  : 0.0560 mW / -12.52 dBm
Laser output power high warning threshold : 0.6300 mW / -2.01 dBm
Laser output power low warning threshold : 0.0890 mW / -10.51 dBm
Module temperature high alarm threshold : 100 degrees C / 212 degrees F
Module temperature low alarm threshold  : -50 degrees C / -58 degrees F
Module temperature high warning threshold : 95 degrees C / 203 degrees F
Module temperature low warning threshold : -48 degrees C / -54 degrees F
Module voltage high alarm threshold      : 3.700 V
Module voltage low alarm threshold       : 2.900 V
Module voltage high warning threshold    : 3.600 V
Module voltage low warning threshold     : 3.000 V
Laser rx power high alarm threshold      : 1.9953 mW / 3.00 dBm
Laser rx power low alarm threshold       : 0.0001 mW / -40.00 dBm
Laser rx power high warning threshold    : 1.0000 mW / 0.00 dBm
Laser rx power low warning threshold     : 0.0010 mW / -30.00 dBm

```

#### show interfaces diagnostics optics (SFP)

```

user@host> show interfaces diagnostics optics ge-0/3/0
Physical interface: ge-0/3/0
Laser bias current           : 23.408 mA
Laser output power           : 1.479 mW / 1.70 dBm
Module temperature           : 37 degrees C / 99 degrees F
Laser rx power               : 0.121 mW / -9.16 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser output power high alarm : Off
Laser output power low alarm  : Off
Module temperature high alarm : Off
Module temperature low alarm  : Off
Laser rx power high alarm     : Off
Laser rx power low alarm      : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser output power high warning : Off
Laser output power low warning : Off
Module temperature high warning : Off
Module temperature low warning : Off
Laser rx power high warning    : Off
Laser rx power low warning     : Off

```

```

Laser bias current high alarm threshold : 31.000 mA
Laser bias current low alarm threshold  : 10.000 mA
Laser output power high alarm threshold : 6.000 mW / 7.78 dBm
Laser output power low alarm threshold  : 0.100 mW / -10.00 dBm
Module temperature high alarm threshold : 85 degrees C / 185 degrees F
Module temperature low alarm threshold  : 0 degrees C / 32 degrees F
Laser rx power high alarm threshold     : 1.000 mW / 0.00 dBm
Laser rx power low alarm threshold      : 0.001 mW / -30.00 dBm
Laser bias current high warning threshold : 28.000 mA
Laser bias current low warning threshold : 11.000 mA
Laser output power high warning threshold : 5.000 mW / 6.99 dBm
Laser output power low warning threshold : 0.500 mW / -3.01 dBm
Module temperature high warning threshold : 70 degrees C / 158 degrees F
Module temperature low warning threshold : 10 degrees C / 50 degrees F
Laser rx power high warning threshold    : 0.501 mW / -3.00 dBm
Laser rx power low warning threshold     : 0.001 mW / -28.86 dBm

```

### show interfaces diagnostics optics (SFP)

```

user@host> show interfaces diagnostics optics ge-1/0/0
Physical interface: ge-1/0/0
Laser bias current           : 49.010 mA
Laser output power          : 1.263 mW / 1.01 dBm
Module temperature           : 17 degrees C / 62 degrees F

Module voltage               : 4.21 V
Laser rx power               : 0.060 mW / -12.21 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser output power high alarm : Off
Laser output power low alarm  : Off
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Laser rx power high alarm     : Off
Laser rx power low alarm      : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser output power high warning : Off
Laser output power low warning : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high warning    : Off
Module voltage low warning     : Off
Laser rx power high warning    : Off
Laser rx power low warning     : Off
Laser bias current high alarm threshold : 70.000 mA
Laser bias current low alarm threshold  : 20.000 mA
Laser bias current high warning threshold : 65.000 mA
Laser bias current low warning threshold : 25.000 mA
Laser output power high alarm threshold : 1.4120 mW / 1.50 dBm
Laser output power low alarm threshold  : 0.1990 mW / -7.01 dBm
Laser output power high warning threshold : 1.2580 mW / 1.00 dBm
Laser output power low warning threshold : 0.2230 mW / -6.52 dBm
Module temperature high alarm threshold : 78 degrees C / 172 degrees F

Module temperature low alarm threshold : 13 degrees C / 9 degrees F
Module temperature high warning threshold : 75 degrees C / 167 degrees F

Module temperature low warning threshold : 10 degrees C / 14 degrees F

```

```

Module voltage high alarm threshold      : 5.71 V
Module voltage low alarm threshold       : 2.05 V
Module voltage high warning threshold    : 5.20 V
Module voltage low warning threshold     : 3.11 V
Laser rx power high alarm threshold      : 1.7783 mW / 2.50 dBm
Laser rx power low alarm threshold       : 0.0100 mW / -20.00 dBm
Laser rx power high warning threshold    : 1.5849 mW / 2.00 dBm
Laser rx power low warning threshold     : 0.0158 mW / -18.01 dBm

```

### show interfaces diagnostics optics (XFP and CFP Optics)

```
user@host> show interfaces diagnostics optics xe-2/1/0
```

```
Physical interface: xe-2/1/0
```

```

Laser bias current          : 52.060 mA
Laser output power          : 0.5640 mW / -2.49 dBm
Module temperature          : 31 degrees C / 88 degrees F
Laser rx power              : 0.0844 mW / -10.74 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser output power high alarm : Off
Laser output power low alarm  : Off
Laser output power high warning : Off
Laser output power low warning : Off
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Laser rx power high alarm     : Off
Laser rx power low alarm      : Off
Laser rx power high warning   : Off
Laser rx power low warning    : Off
Module not ready alarm        : Off
Module power down alarm       : Off
Tx data not ready alarm       : Off
Tx not ready alarm            : Off
Tx laser fault alarm          : Off
Tx CDR loss of lock alarm     : Off
Rx not ready alarm            : Off
Rx loss of signal alarm       : Off
Rx CDR loss of lock alarm     : Off
Laser bias current high alarm threshold : 130.000 mA
Laser bias current low alarm threshold  : 10.000 mA
Laser bias current high warning threshold : 120.000 mA
Laser bias current low warning threshold : 12.000 mA
Laser output power high alarm threshold : 0.8910 mW / -0.50 dBm
Laser output power low alarm threshold  : 0.2230 mW / -6.52 dBm
Laser output power high warning threshold : 0.7940 mW / -1.00 dBm
Laser output power low warning threshold : 0.2510 mW / -6.00 dBm
Module temperature high alarm threshold : 90 degrees C / 194 degrees F
Module temperature low alarm threshold  : -5 degrees C / 23 degrees F
Module temperature high warning threshold : 85 degrees C / 185 degrees F
Module temperature low warning threshold : 0 degrees C / 32 degrees F
Laser rx power high alarm threshold     : 1.2589 mW / 1.00 dBm
Laser rx power low alarm threshold      : 0.0323 mW / -14.91 dBm
Laser rx power high warning threshold   : 1.1220 mW / 0.50 dBm
Laser rx power low warning threshold    : 0.0363 mW / -14.40 dBm

```



### show interfaces diagnostics optics for 10-Gigabit Ethernet (PTX 24-10GE-SFPP)

```
user@host> show interfaces diagnostics optics et-2/0/23
```

```
Physical interface: et-2/0/23
```

```

Laser bias current           : 8.482 mA
Laser output power          : 0.5890 mW / -2.30 dBm
Module temperature          : 51 degrees C / 123 degrees F
Module voltage              : 3.2970 V
Receiver signal average optical power : 0.5574 mW / -2.54 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser output power high alarm : Off
Laser output power low alarm  : Off
Laser output power high warning : Off
Laser output power low warning : Off
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Module voltage high warning   : Off
Module voltage low warning    : Off
Laser rx power high alarm     : Off
Laser rx power low alarm      : Off
Laser rx power high warning   : Off
Laser rx power low warning    : Off
Laser bias current high alarm threshold : 11.800 mA
Laser bias current low alarm threshold : 4.000 mA
Laser bias current high warning threshold : 10.800 mA
Laser bias current low warning threshold : 5.000 mA
Laser output power high alarm threshold : 0.8310 mW / -0.80 dBm
Laser output power low alarm threshold : 0.2510 mW / -6.00 dBm
Laser output power high warning threshold : 0.6600 mW / -1.80 dBm
Laser output power low warning threshold : 0.3160 mW / -5.00 dBm
Module temperature high alarm threshold : 93 degrees C / 199 degrees F
Module temperature low alarm threshold : -13 degrees C / 9 degrees F
Module temperature high warning threshold : 88 degrees C / 190 degrees F
Module temperature low warning threshold : -8 degrees C / 18 degrees F
Module voltage high alarm threshold : 3.700 V
Module voltage low alarm threshold : 2.900 V
Module voltage high warning threshold : 3.600 V
Module voltage low warning threshold : 3.000 V
Laser rx power high alarm threshold : 1.0000 mW / 0.00 dBm
Laser rx power low alarm threshold : 0.0100 mW / -20.00 dBm
Laser rx power high warning threshold : 0.7943 mW / -1.00 dBm
Laser rx power low warning threshold : 0.0158 mW / -18.01 dBm

```

### show interfaces diagnostics optics for 40-Gigabit Ethernet

```
user@host> show interfaces diagnostics optics et-7/1/0
```

```
Physical interface: et-7/1/0
```

```

Module temperature          : 34 degrees C / 94 degrees F
Module voltage              : 3.4720 V
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off

```

```

Module voltage high alarm           : Off
Module voltage low alarm            : Off
Module voltage high warning         : Off
Module voltage low warning          : Off
Module not ready alarm              : Off
Module low power alarm              : Off
Module initialization incomplete alarm : Off
Module fault alarm                  : Off
PLD Flash initialization fault alarm : Off
Power supply fault alarm            : Off
Checksum fault alarm                : Off
Tx laser disabled alarm             : Off
Tx loss of signal functionality alarm : Off
Tx CDR loss of lock alarm           : Off
Rx loss of signal alarm             : Off
Rx CDR loss of lock alarm           : Off
Module temperature high alarm threshold : 80 degrees C / 176 degrees F
Module temperature low alarm threshold : -10 degrees C / 14 degrees F
Module temperature high warning threshold : 75 degrees C / 167 degrees F
Module temperature low warning threshold : -5 degrees C / 23 degrees F
Module voltage high alarm threshold : 3.5990 V
Module voltage low alarm threshold : 3.0000 V
Module voltage high warning threshold : 3.5000 V
Module voltage low warning threshold : 3.0990 V
Laser bias current high alarm threshold : 100.000 mA
Laser bias current low alarm threshold : 10.000 mA
Laser bias current high warning threshold : 80.000 mA
Laser bias current low warning threshold : 15.000 mA
Laser output power high alarm threshold : 2.8180 mW / 4.50 dBm
Laser output power low alarm threshold : 0.2390 mW / -6.22 dBm
Laser output power high warning threshold : 2.2380 mW / 3.50 dBm
Laser output power low warning threshold : 0.3010 mW / -5.21 dBm
Laser rx power high alarm threshold : 2.5119 mW / 4.00 dBm
Laser rx power low alarm threshold : 0.0316 mW / -15.00 dBm
Laser rx power high warning threshold : 1.9953 mW / 3.00 dBm
Laser rx power low warning threshold : 0.0631 mW / -12.00 dBm
Laser temperature high alarm threshold : 80 degrees C / 176 degrees F
Laser temperature low alarm threshold : -10 degrees C / 14 degrees F
Laser temperature high warning threshold : 75 degrees C / 167 degrees F
Laser temperature low warning threshold : -5 degrees C / 23 degrees F
Lane 0
Laser bias current                 : 27.829 mA
Laser output power                 : 0.851 mW / -0.70 dBm
Laser temperature                 : 34 degrees C / 94 degrees F
Laser receiver power              : 0.894 mW / -0.49 dBm
Laser bias current high alarm      : Off
Laser bias current low alarm       : Off
Laser bias current high warning    : Off
Laser bias current low warning     : Off
Laser output power high alarm      : Off
Laser output power low alarm       : Off
Laser output power high warning    : Off
Laser output power low warning     : Off
Laser temperature high alarm       : Off
Laser temperature low alarm        : Off
Laser temperature high warning     : Off
Laser temperature low warning      : Off
Laser receiver power high alarm    : Off
Laser receiver power low alarm     : Off
Laser receiver power high warning  : Off
Laser receiver power low warning   : Off

```

```

Tx loss of signal functionality alarm : Off
Tx CDR loss of lock alarm           : Off
Rx loss of signal alarm             : Off
Rx CDR loss of lock alarm           : Off
APD supply fault alarm              : Off
TEC fault alarm                     : Off
Wavelength unlocked alarm           : Off

Lane 1
Laser bias current                  : 35.374 mA
Laser output power                   : 0.896 mW / -0.48 dBm
Laser temperature                    : 34 degrees C / 94 degrees F
Laser receiver power                 : 0.707 mW / -1.50 dBm
Laser bias current high alarm        : Off
Laser bias current low alarm         : Off
Laser bias current high warning      : Off
Laser bias current low warning       : Off
Laser output power high alarm        : Off
Laser output power low alarm         : Off
Laser output power high warning      : Off
Laser output power low warning       : Off
Laser temperature high alarm         : Off
Laser temperature low alarm          : Off
Laser temperature high warning       : Off
Laser temperature low warning        : Off
Laser receiver power high alarm       : Off
Laser receiver power low alarm        : Off
Laser receiver power high warning     : Off
Laser receiver power low warning      : Off
Tx loss of signal functionality alarm : Off
Tx CDR loss of lock alarm             : Off
Rx loss of signal alarm               : Off
Rx CDR loss of lock alarm             : Off
APD supply fault alarm                : Off
TEC fault alarm                      : Off
Wavelength unlocked alarm             : Off

Lane 2
Laser bias current                  : 29.173 mA
Laser output power                   : 0.890 mW / -0.51 dBm
Laser temperature                    : 34 degrees C / 94 degrees F
Laser receiver power                 : 0.704 mW / -1.52 dBm
Laser bias current high alarm        : Off
Laser bias current low alarm         : Off
Laser bias current high warning      : Off
Laser bias current low warning       : Off
Laser output power high alarm        : Off
Laser output power low alarm         : Off
Laser output power high warning      : Off
Laser output power low warning       : Off
Laser temperature high alarm         : Off
Laser temperature low alarm          : Off
Laser temperature high warning       : Off
Laser temperature low warning        : Off
Laser receiver power high alarm       : Off
Laser receiver power low alarm        : Off
Laser receiver power high warning     : Off
Laser receiver power low warning      : Off
Tx loss of signal functionality alarm : Off
Tx CDR loss of lock alarm             : Off
Rx loss of signal alarm               : Off
Rx CDR loss of lock alarm             : Off
APD supply fault alarm                : Off

```

```

    TEC fault alarm                : Off
    Wavelength unlocked alarm      : Off
  Lane 3
    Laser bias current             : 36.164 mA
    Laser output power             : 0.899 mW / -0.46 dBm
    Laser temperature              : 34 degrees C / 94 degrees F
    Laser receiver power           : 0.892 mW / -0.50 dBm
    Laser bias current high alarm  : Off
    Laser bias current low alarm   : Off
    Laser bias current high warning : Off
    Laser bias current low warning : Off
    Laser output power high alarm  : Off
    Laser output power low alarm   : Off
    Laser output power high warning : Off
    Laser output power low warning : Off
    Laser temperature high alarm   : Off
    Laser temperature low alarm    : Off
    Laser temperature high warning : Off
    Laser temperature low warning  : Off
    Laser receiver power high alarm : Off
    Laser receiver power low alarm  : Off
    Laser receiver power high warning : Off
    Laser receiver power low warning : Off
    Tx loss of signal functionality alarm : Off
    Tx CDR loss of lock alarm      : Off
    Rx loss of signal alarm        : Off
    Rx CDR loss of lock alarm      : Off
    APD supply fault alarm         : Off
    TEC fault alarm                : Off
    Wavelength unlocked alarm      : Off

```

#### show interfaces diagnostics optics (PI-PTX-24-10G-W-SFPP )

```

user@host> show interfaces diagnostics optics ge-3/0/6
Physical interface: ge-3/0/6
    Laser bias current             : 13.356 mA
    Laser output power             : 0.2210 mW / -6.56 dBm
    Module temperature             : 36 degrees C / 96 degrees F
    Module voltage                 : 3.2180 V
    Receiver signal average optical power : 0.2429 mW / -6.15 dBm
    Wavelength Channel number      : 1
    Wavelength setpoint            : 1568.80 nm
    Tx Dither                     : Disabled
    Frequency Error                : 0.00 GHz
    Wavelength Error               : 0.00 nm
    Laser bias current high alarm  : Off
    Laser bias current low alarm   : Off
    Laser bias current high warning : Off
    Laser bias current low warning : Off
    Laser output power high alarm  : Off
    Laser output power low alarm   : Off
    Laser output power high warning : Off
    Laser output power low warning : Off
    Module temperature high alarm  : Off
    Module temperature low alarm   : Off
    Module temperature high warning : Off
    Module temperature low warning  : Off
    Module voltage high alarm      : Off
    Module voltage low alarm       : Off
    Module voltage high warning    : Off
    Module voltage low warning     : Off

```

```

Laser rx power high alarm           : Off
Laser rx power low alarm            : Off
Laser rx power high warning         : Off
Laser rx power low warning          : Off
TEC fault alarm                     : Off
Wavelength unlocked alarm           : Off
Tx Tune                             : Off
Laser bias current high alarm threshold : 70.000 mA
Laser bias current low alarm threshold : 0.002 mA
Laser bias current high warning threshold : 65.000 mA
Laser bias current low warning threshold : 0.002 mA
Laser output power high alarm threshold : 1.0000 mW / 0.00 dBm
Laser output power low alarm threshold : 0.0560 mW / -12.52 dBm
Laser output power high warning threshold : 0.6300 mW / -2.01 dBm
Laser output power low warning threshold : 0.0890 mW / -10.51 dBm
Module temperature high alarm threshold : 100 degrees C / 212 degrees F
Module temperature low alarm threshold : -50 degrees C / -58 degrees F
Module temperature high warning threshold : 95 degrees C / 203 degrees F
Module temperature low warning threshold : -48 degrees C / -54 degrees F
Module voltage high alarm threshold : 3.700 V
Module voltage low alarm threshold : 2.900 V
Module voltage high warning threshold : 3.600 V
Module voltage low warning threshold : 3.000 V
Laser rx power high alarm threshold : 1.9953 mW / 3.00 dBm
Laser rx power low alarm threshold : 0.0001 mW / -40.00 dBm
Laser rx power high warning threshold : 1.0000 mW / 0.00 dBm
Laser rx power low warning threshold : 0.0010 mW / -30.00 dBm

```

#### show interfaces diagnostics optics (P2-10G-40G-QSFP PIC in 40-Gigabit Ethernet mode)

```
user@host> show interfaces diagnostics optics et-0/1/5
```

```
Physical interface: et-0/1/5
```

```

Module temperature           : 30 degrees C / 85 degrees F
Module voltage               : 3.2760 V
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Module voltage high warning   : Off
Module voltage low warning    : Off
Module temperature high alarm threshold : 75 degrees C / 167 degrees F
Module temperature low alarm threshold : 5 degrees C / 41 degrees F
Module temperature high warning threshold : 70 degrees C / 158 degrees F
Module temperature low warning threshold : 0 degrees C / 32 degrees F
Module voltage high alarm threshold : 3.6300 V
Module voltage low alarm threshold : 2.9700 V
Module voltage high warning threshold : 3.4640 V
Module voltage low warning threshold : 3.1340 V
Laser bias current high alarm threshold : 10.000 mA
Laser bias current low alarm threshold : 0.500 mA
Laser bias current high warning threshold : 9.500 mA
Laser bias current low warning threshold : 1.000 mA
Laser output power high alarm threshold : 0.0000 mW / - Inf dBm
Laser output power low alarm threshold : 0.0000 mW / - Inf dBm
Laser output power high warning threshold : 0.0000 mW / - Inf dBm
Laser output power low warning threshold : 0.0000 mW / - Inf dBm
Laser rx power high alarm threshold : 2.1878 mW / 3.40 dBm
Laser rx power low alarm threshold : 0.0446 mW / -13.51 dBm
Laser rx power high warning threshold : 1.7378 mW / 2.40 dBm

```

```

    Laser rx power low warning threshold      : 0.1122 mW / -9.50 dBm
Lane 0
    Laser bias current                       : 7.065 mA
    Laser output power                      : 0.710 mW / -1.49 dBm
    Laser receiver power                    : 0.472 mW / -3.26 dBm
    Laser bias current high alarm           : Off
    Laser bias current low alarm            : Off
    Laser bias current high warning         : Off
    Laser bias current low warning          : Off
    Laser receiver power high alarm         : Off
    Laser receiver power low alarm          : Off
    Laser receiver power high warning       : Off
    Laser receiver power low warning        : Off
    Tx loss of signal functionality alarm    : Off
    Rx loss of signal alarm                 : Off
Lane 1
    Laser bias current                       : 6.978 mA
    Laser output power                      : 0.771 mW / -1.13 dBm
    Laser receiver power                    : 0.450 mW / -3.47 dBm
    Laser bias current high alarm           : Off
    Laser bias current low alarm            : Off
    Laser bias current high warning         : Off
    Laser bias current low warning          : Off
    Laser receiver power high alarm         : Off
    Laser receiver power low alarm          : Off
    Laser receiver power high warning       : Off
    Laser receiver power low warning        : Off
    Tx loss of signal functionality alarm    : Off
    Rx loss of signal alarm                 : Off
Lane 2
    Laser bias current                       : 6.955 mA
    Laser output power                      : 0.760 mW / -1.19 dBm
    Laser receiver power                    : 0.556 mW / -2.55 dBm
    Laser bias current high alarm           : Off
    Laser bias current low alarm            : Off
    Laser bias current high warning         : Off
    Laser bias current low warning          : Off
    Laser receiver power high alarm         : Off
    Laser receiver power low alarm          : Off
    Laser receiver power high warning       : Off
    Laser receiver power low warning        : Off
    Tx loss of signal functionality alarm    : Off
    Rx loss of signal alarm                 : Off
Lane 3
    Laser bias current                       : 6.981 mA
    Laser output power                      : 0.736 mW / -1.33 dBm
    Laser receiver power                    : 0.537 mW / -2.70 dBm
    Laser bias current high alarm           : Off
    Laser bias current low alarm            : Off
    Laser bias current high warning         : Off
    Laser bias current low warning          : Off
    Laser receiver power high alarm         : Off
    Laser receiver power low alarm          : Off
    Laser receiver power high warning       : Off
    Laser receiver power low warning        : Off
    Tx loss of signal functionality alarm    : Off
    Rx loss of signal alarm                 : Off

```

**show interfaces diagnostics optics (P2-10G-40G-QSFP PIC in 10-Gigabit Ethernet mode)**

```
user@host> show interfaces diagnostics optics et-0/1/5:3
```

```

Physical interface: et-0/1/5:3
Module temperature           : 30 degrees C / 85 degrees F
Module voltage               : 3.2760 V
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Module voltage high warning   : Off
Module voltage low warning    : Off
Module temperature high alarm threshold : 75 degrees C / 167 degrees F
Module temperature low alarm threshold  : 5 degrees C / 41 degrees F
Module temperature high warning threshold : 70 degrees C / 158 degrees F
Module temperature low warning threshold : 0 degrees C / 32 degrees F
Module voltage high alarm threshold     : 3.6300 V
Module voltage low alarm threshold      : 2.9700 V
Module voltage high warning threshold   : 3.4640 V
Module voltage low warning threshold    : 3.1340 V
Laser bias current high alarm threshold : 10.000 mA
Laser bias current low alarm threshold  : 0.500 mA
Laser bias current high warning threshold : 9.500 mA
Laser bias current low warning threshold : 1.000 mA
Laser output power high alarm threshold : 0.0000 mW / - Inf dBm
Laser output power low alarm threshold  : 0.0000 mW / - Inf dBm
Laser output power high warning threshold : 0.0000 mW / - Inf dBm
Laser output power low warning threshold : 0.0000 mW / - Inf dBm
Laser rx power high alarm threshold     : 2.1878 mW / 3.40 dBm
Laser rx power low alarm threshold      : 0.0446 mW / -13.51 dBm
Laser rx power high warning threshold   : 1.7378 mW / 2.40 dBm
Laser rx power low warning threshold    : 0.1122 mW / -9.50 dBm
Lane 3
Laser bias current           : 6.981 mA
Laser output power           : 0.736 mW / -1.33 dBm
Laser receiver power         : 0.537 mW / -2.70 dBm
Laser bias current high alarm : Off
Laser bias current low alarm  : Off
Laser bias current high warning : Off
Laser bias current low warning : Off
Laser receiver power high alarm : Off
Laser receiver power low alarm  : Off
Laser receiver power high warning : Off
Laser receiver power low warning : Off
Tx loss of signal functionality alarm : Off
Rx loss of signal alarm             : Off

```

#### show interfaces diagnostics optics (PI-PTX-2-100G-WDM)

```

user@host> show interfaces diagnostics optics et-1/0/0
Physical interface: et-1/0/0
Module temperature           : 37 degrees C / 98 degrees F
Module voltage               : 3.3370 V
Module temperature high alarm : Off
Module temperature low alarm  : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm     : Off
Module voltage low alarm      : Off
Module voltage high warning   : Off
Module voltage low warning    : Off
Module not ready alarm       : Off

```

```

Module low power alarm                : Off
Module initialization incomplete alarm : Off
Module fault alarm                    : Off
PLD Flash initialization fault alarm  : Off
Power supply fault alarm               : Off
Checksum fault alarm                  : Off
Tx laser disabled alarm                : Off
Tx loss of signal functionality alarm  : Off
Tx CDR loss of lock alarm              : Off
Rx loss of signal alarm                : Off
Rx CDR loss of lock alarm              : Off
Module temperature high alarm threshold : 70 degrees C / 158 degrees F
Module temperature low alarm threshold  : 0 degrees C / 32 degrees F
Module temperature high warning threshold : 68 degrees C / 154 degrees F
Module temperature low warning threshold : 2 degrees C / 36 degrees F
Module voltage high alarm threshold     : 3.4640 V
Module voltage low alarm threshold      : 3.1340 V
Module voltage high warning threshold   : 3.4310 V
Module voltage low warning threshold    : 3.1670 V
Laser bias current high alarm threshold : 300.000 mA
Laser bias current low alarm threshold  : 75.000 mA
Laser bias current high warning threshold : 287.500 mA
Laser bias current low warning threshold : 87.500 mA
Rx power high alarm threshold           : 2.8184 mW / 4.50 dBm
Rx power low alarm threshold             : 0.0251 mW / -16.00 dBm
Rx power high warning threshold          : 2.5119 mW / 4.00 dBm
Rx power low warning threshold           : 0.0501 mW / -13.00 dBm
Laser temperature high alarm threshold  : 57 degrees C / 135 degrees F
Laser temperature low alarm threshold   : 25 degrees C / 77 degrees F
Laser temperature high warning threshold : 55 degrees C / 131 degrees F
Laser temperature low warning threshold  : 27 degrees C / 81 degrees F
Lane 0
Laser bias current                      : 164.384 mA
Output power                            : 1.181 mW / 0.72 dBm
Laser temperature                       : 41 degrees C / 106 degrees F
Receiver power                          : 0.632 mW / -1.99 dBm
Laser bias current high alarm           : Off
Laser bias current low alarm            : Off
Laser bias current high warning         : Off
Laser bias current low warning          : Off
Tx power high alarm                     : Off
Tx power low alarm                      : Off
Tx power high warning                   : Off
Tx power low warning                    : Off
Laser temperature high alarm            : Off
Laser temperature low alarm             : Off
Laser temperature high warning          : Off
Laser temperature low warning           : Off
Laser receiver power high alarm         : Off
Laser receiver power low alarm          : Off
Laser receiver power high warning       : Off
Laser receiver power low warning        : Off
Tx loss of signal functionality alarm    : Off
Tx CDR loss of lock alarm                : Off
Rx loss of signal alarm                 : Off
Rx CDR loss of lock alarm                : Off
APD supply fault alarm                  : Off
TEC fault alarm                         : Off
Wavelength unlocked alarm                : Off

```



### show interfaces diagnostics optics (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```

user@host> show interfaces diagnostics optics et-2/0/0
Physical interface: et-2/0/0
  Module temperature           : 39 degrees C / 102 degrees F
  Module voltage               : 3.2300 V
  Module temperature high alarm : Off
  Module temperature low alarm  : Off
  Module temperature high warning : Off
  Module temperature low warning : Off
  Module voltage high alarm     : Off
  Module voltage low alarm      : Off
  Module voltage high warning   : Off
  Module voltage low warning    : Off
  Module not ready alarm        : Off
  Module low power alarm        : Off
  Module initialization incomplete alarm : Off
  Module fault alarm           : Off
  Tx laser disabled alarm       : Off
  Rx loss of signal alarm       : Off
  Module temperature high alarm threshold : 90 degrees C / 194 degrees F
  Module temperature low alarm threshold : -20 degrees C / -4 degrees F
  Module temperature high warning threshold : 0 degrees C / 32 degrees F
  Module temperature low warning threshold : 0 degrees C / 32 degrees F
  Module voltage high alarm threshold : 3.6300 V
  Module voltage low alarm threshold : 2.9700 V
  Module voltage high warning threshold : 0.0000 V
  Module voltage low warning threshold : 0.0000 V
  Rx power high alarm threshold : 6.5535 mW / 8.16 dBm
  Rx power low alarm threshold : 0.0028 mW / -25.53 dBm
  Rx power high warning threshold : 6.5535 mW / 8.16 dBm
  Rx power low warning threshold : 0.0028 mW / -25.53 dBm
  LOS alarm threshold           : 0.0028 mW / -25.53 dBm
  LOS warning threshold         : 0.0028 mW / -25.53 dBm
  Modem lock state              : OK
Lane 0
  Tx power                     : 1.000 mW / 0.00 dBm
  Module temperature           : 51 degrees C / 124 degrees F
  Rx power (total)              : 0.644 mW / -1.91 dBm
  Rx power (signal)             : 0.618 mW / -2.09 dBm
  Lane chromatic dispersion     : -22 ps/nm
  Lane differential group delay : 5 ps
  Lane Q2 factor                : 14.20 dB
  Lane carrier frequency offset : -534 Mz
  Lane electrical SNR           : 9.20 dB
  Tx power high alarm           : Off
  Tx power low alarm            : Off
  Tx power high warning         : Off
  Tx power low warning          : Off
  Rx power high alarm           : Off
  Rx power low alarm            : Off
  Rx power high warning         : Off
  Rx power low warning          : Off
  Rx loss of signal alarm       : Off
  Wavelength unlocked alarm     : Off

```

### show interfaces diagnostics optics (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

```

user@host> show interfaces diagnostics optics et-4/0/0
Physical interface: et-4/0/0
  Laser output power           : 54 degrees C / 129 degrees F

```

```

Tx module temperature                : 0.0000
Module temperature high alarm        : Off
Module temperature low alarm         : Off
Module temperature high warning      : Off
Module temperature low warning       : Off
Module voltage high alarm            : Off
Module voltage low alarm             : Off
Module voltage high warning          : Off
Module voltage low warning           : Off
Module not ready alarm               : Off
Module low power alarm               : Off
Module initialization incomplete alarm : Off
Module fault alarm                   : Off
PLD Flash initialization fault alarm : Off
Power supply fault alarm             : Off
Checksum fault alarm                 : Off
Tx laser disabled alarm              : Off
Rx loss of signal alarm              : Off
Module temperature high alarm threshold : 80 degrees C / 176 degrees F
Module temperature low alarm threshold : 0 degrees C / 32 degrees F
Module temperature high warning threshold : 65 degrees C / 149 degrees F
Module temperature low warning threshold : 5 degrees C / 41 degrees F
Module voltage high alarm threshold   : 0.0000 V
Module voltage low alarm threshold    : 0.0000 V
Module voltage high warning threshold : 0.0000 V
Module voltage low warning threshold  : 0.0000 V
Rx power high alarm threshold         : 0.0000 mW / - Inf dBm
Rx power low alarm threshold          : 0.0000 mW / - Inf dBm
Rx power high warning threshold       : 0.0000 mW / - Inf dBm
Rx power low warning threshold        : 0.0000 mW / - Inf dBm
LOS alarm threshold                   : 0.0158 mW / -18.01 dBm
LOS warning threshold                 : 0.0251 mW / -16.00 dBm
Modem lock state                      : OK
Lane 0
Tx power                             : 1.000 mW / 0.00 dBm
Module temperature                    : 0 degrees C / 32 degrees F
Rx power (total)                      : 0.000 mW / - Inf dBm
Rx power (signal)                    : 0.999 mW / -0.00 dBm
Lane chromatic dispersion             : 6 ps/nm
Lane differential group delay          : 3 ps
Lane Q2 factor                        : 15.40 dB
Lane carrier frequency offset         : 0 MHz
Lane electrical SNR                   : 16.60 dB
Tx power high alarm                   : Off
Tx power low alarm                    : Off
Tx power high warning                 : Off
Tx power low warning                  : Off
Rx power high alarm                   : Off
Rx power low alarm                    : Off
Rx power high warning                 : Off
Rx power low warning                   : Off
Rx power low warning                   : Off
Rx loss of signal alarm               : Off
Wavelength unlocked alarm             : Off
Laser end-of-life alarm               : Off
Lane 1
Tx power                             : 1.000 mW / 0.00 dBm
Module temperature                    : 0 degrees C / 32 degrees F
Rx power (total)                      : 0.000 mW / - Inf dBm
Rx power (signal)                    : 0.999 mW / -0.00 dBm
Tx power high alarm                   : Off
Tx power low alarm                    : Off

```

```

Tx power high warning           : Off
Tx power low warning            : Off
Rx power high alarm             : Off
Rx power low alarm              : Off
Rx power high warning           : Off
Rx power low warning            : Off
Rx loss of signal alarm         : Off
Wavelength unlocked alarm       : Off
Laser end-of-life alarm         : Off
Lane 2
Tx power                        : 1.000 mW / 0.00 dBm
Module temperature              : 0 degrees C / 32 degrees F
Rx power (total)                : 0.000 mW / - Inf dBm
Rx power (signal)              : 0.999 mW / -0.00 dBm
Tx power high alarm             : Off
Tx power low alarm              : Off
Tx power high warning           : Off
Tx power low warning            : Off
Rx power high alarm             : Off
Rx power low alarm              : Off
Rx power high warning           : Off
Rx power low warning            : Off
Rx loss of signal alarm         : Off
Wavelength unlocked alarm       : Off
Laser end-of-life alarm         : Off
Lane 3
Tx power                        : 1.000 mW / 0.00 dBm
Module temperature              : 0 degrees C / 32 degrees F
Rx power (total)                : 0.000 mW / - Inf dBm
Rx power (signal)              : 0.999 mW / -0.00 dBm
Tx power high alarm             : Off
Tx power low alarm              : Off
Tx power high warning           : Off
Tx power low warning            : Off
Rx power high alarm             : Off
Rx power low alarm              : Off
Rx power high warning           : Off
Rx power low warning            : Off
Rx loss of signal alarm         : Off
Wavelength unlocked alarm       : Off
Laser end-of-life alarm         : Off

```

### show interfaces diagnostics optics for vcp

```

ser@host> show interfaces diagnostics optics vcp-2/0/1
Physical interface: vcp-2/0/1
Laser bias current              : 5.494 mA
Laser output power              : 0.2960 mW / -5.29 dBm
Module temperature              : 22 degrees C / 71 degrees F
Module voltage                  : 3.2810 V
Receiver signal average optical power : 0.2426 mW / -6.15 dBm
Laser bias current high alarm   : Off
Laser bias current low alarm    : Off
Laser bias current high warning : Off
Laser bias current low warning  : Off
Laser output power high alarm   : Off
Laser output power low alarm    : Off
Laser output power high warning : Off
Laser output power low warning  : Off
Module temperature high alarm    : Off
Module temperature low alarm     : Off

```

```
Module temperature high warning      : Off
Module temperature low warning       : Off
Module voltage high alarm            : Off
Module voltage low alarm             : Off
Module voltage high warning          : Off
Module voltage low warning           : Off
Laser rx power high alarm            : Off
Laser rx power low alarm             : Off
Laser rx power high warning          : Off
Laser rx power low warning           : Off
Laser bias current high alarm threshold : 17.000 mA
Laser bias current low alarm threshold : 1.000 mA
Laser bias current high warning threshold : 14.000 mA
Laser bias current low warning threshold : 2.000 mA
Laser output power high alarm threshold : 0.6310 mW / -2.00 dBm
Laser output power low alarm threshold : 0.0670 mW / -11.74 dBm
Laser output power high warning threshold : 0.6310 mW / -2.00 dBm
Laser output power low warning threshold : 0.0790 mW / -11.02 dBm
Module temperature high alarm threshold : 95 degrees C / 203 degrees F
Module temperature low alarm threshold : -25 degrees C / -13 degrees F
Module temperature high warning threshold : 90 degrees C / 194 degrees F
Module temperature low warning threshold : -20 degrees C / -4 degrees F
Module voltage high alarm threshold : 3.900 V
Module voltage low alarm threshold : 2.700 V
Module voltage high warning threshold : 3.700 V
Module voltage low warning threshold : 2.900 V
Laser rx power high alarm threshold : 1.2590 mW / 1.00 dBm
Laser rx power low alarm threshold : 0.0100 mW / -20.00 dBm
Laser rx power high warning threshold : 0.7940 mW / -1.00 dBm
Laser rx power low warning threshold : 0.0158 mW / -18.01 dBm
```

## show interfaces (far-end-interval)

|                                 |                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show interfaces far-end-interval <i>interface-fpc/pic/port</i></code>                                                                                                    |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4.                                                                                                                                    |
| <b>Description</b>              | On channelized interfaces, display the far end interval data for the specified interface.                                                                                      |
| <b>Required Privilege Level</b> | view                                                                                                                                                                           |
| <b>List of Sample Output</b>    | <a href="#">show interfaces far-end-interval coc12-5/2/0 on page 1561</a><br><a href="#">show interfaces far-end-interval coc1-5/2/1:1 on page 1562</a>                        |
| <b>Output Fields</b>            | Table 97 on page 1561 lists the output fields for the <b>show interfaces far-end-interval</b> command. Output fields are listed in the approximate order in which they appear. |

**Table 97: show interfaces far-end-interval Output Fields**

| Field Name         | Field Description                         |
|--------------------|-------------------------------------------|
| Physical interface | Interface FPC/PIC/port values.            |
| SNMP ifIndex       | SNMP interface index value.               |
| ES-L/P             | Error detection—Errored seconds.          |
| SES-L/P            | Error detection—Severely errored seconds. |
| UAS-L/P            | Error detection—Unavailable seconds.      |

## Sample Output

### show interfaces far-end-interval coc12-5/2/0

```

user@host> show interfaces far-end-interval coc12-5/2/0
Physical interface: coc12-5/2/0, SNMP ifIndex: 121
05:30-current:
  ES-L: 1, SES-L: 1, UAS-L: 0
05:15-05:30:
  ES-L: 0, SES-L: 0, UAS-L: 0
05:00-05:15:
  ES-L: 0, SES-L: 0, UAS-L: 0
04:45-05:00:
  ES-L: 0, SES-L: 0, UAS-L: 0
04:30-04:45:
  ES-L: 0, SES-L: 0, UAS-L: 0
04:15-04:30:
  ES-L: 0, SES-L: 0, UAS-L: 0
04:00-04:15:
...

```

**show interfaces far-end-interval coc1-5/2/1:1**

```
user@host> run show interfaces far-end-interval coc1-5/2/1:1
Physical interface: coc1-5/2/1:1, SNMP ifIndex: 342
05:30-current:
    ES-L: 1, SES-L: 1, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
05:15-05:30:
    ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
05:00-05:15:
    ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
04:45-05:00:
    ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
04:30-04:45:
    ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
04:15-04:30:
    ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P: 0, UAS-P: 0
04:00-04:15:
```

## show interfaces (Fast Ethernet)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show interfaces <i>interface-type</i><br><brief   detail   extensive   terse><br><descriptions><br><media><br><snmp-index <i>snmp-index</i> ><br><statistics>                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Display status information about the specified Fast Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p><i>interface-type</i>—On M Series and T Series routers, the interface type is <b>fe-fpc/pic/port</b>.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>List of Sample Output</b>    | <a href="#">show interfaces (Fast Ethernet) on page 1576</a><br><a href="#">show interfaces brief (Fast Ethernet) on page 1577</a><br><a href="#">show interfaces detail (Fast Ethernet) on page 1577</a><br><a href="#">show interfaces extensive (Fast Ethernet) on page 1577</a>                                                                                                                                                                                                                                                                                                        |
| <b>Output Fields</b>            | Table 98 on page 1563 lists the output fields for the <b>show interfaces</b> (Fast Ethernet) command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                              |

Table 98: show interfaces Fast Ethernet Output Fields

| Field Name                | Field Description                                                                                                                    | Level of Output              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Physical Interface</b> |                                                                                                                                      |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                      | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> . | All levels                   |
| <b>Interface index</b>    | Index number of the physical interface, which reflects its initialization sequence.                                                  | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                        | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                    | <b>detail extensive</b>      |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name       | Field Description                                                                                                                                                                                                                                   | Level of Output  |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Link-level type  | Encapsulation being used on the physical interface.                                                                                                                                                                                                 | All levels       |
| MTU              | Maximum transmission unit size on the physical interface.                                                                                                                                                                                           | All levels       |
| Link-mode        | Type of link connection configured for the physical interface: <b>Full-duplex</b> or <b>Half-duplex</b>                                                                                                                                             | <b>extensive</b> |
| Speed            | Speed at which the interface is running.                                                                                                                                                                                                            | All levels       |
| Loopback         | Loopback status: <b>Enabled</b> or <b>Disabled</b> . If loopback is enabled, type of loopback: <b>Local</b> or <b>Remote</b> .                                                                                                                      | All levels       |
| Source filtering | Source filtering status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                        | All levels       |
| LAN-PHY mode     | 10-Gigabit Ethernet interface operating in Local Area Network Physical Layer Device (LAN PHY) mode. LAN PHY allows 10-Gigabit Ethernet wide area links to use existing Ethernet applications.                                                       | All levels       |
| WAN-PHY mode     | 10-Gigabit Ethernet interface operating in Wide Area Network Physical Layer Device (WAN PHY) mode. WAN PHY allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and other devices intended for SONET/SDH.                           | All levels       |
| Unidirectional   | Unidirectional link mode status for 10-Gigabit Ethernet interface: <b>Enabled</b> or <b>Disabled</b> for parent interface; <b>Rx-only</b> or <b>Tx-only</b> for child interfaces.                                                                   | All levels       |
| Flow control     | Flow control status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                            | All levels       |
| Auto-negotiation | (Gigabit Ethernet interfaces) Autonegotiation status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                           | All levels       |
| Remote-fault     | (Gigabit Ethernet interfaces) Remote fault status: <ul style="list-style-type: none"> <li>• <b>Online</b>—Autonegotiation is manually configured as online.</li> <li>• <b>Offline</b>—Autonegotiation is manually configured as offline.</li> </ul> | All levels       |
| Device flags     | Information about the physical device. Possible values are described in the "Device Flags" section under <i>Common Output Fields Description</i> .                                                                                                  | All levels       |
| Interface flags  | Information about the interface. Possible values are described in the "Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                     | All levels       |
| Link flags       | Information about the link. Possible values are described in the "Links Flags" section under <i>Common Output Fields Description</i> .                                                                                                              | All levels       |
| Wavelength       | (10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).                                                                                                              | All levels       |
| Frequency        | (10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).                                                                                                                    | All levels       |



Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output       |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| CoS queues              | Number of CoS queues configured.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | detail extensive none |
| Schedulers              | (GigabitEthernet intelligent queuing 2 (IQ2) interfaces only) Number of CoS schedulers configured.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | extensive             |
| Hold-times              | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | detail extensive      |
| Current address         | Configured MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | detail extensive none |
| Hardware address        | Hardware MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | detail extensive none |
| Last flapped            | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | detail extensive none |
| Input Rate              | Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | None specified        |
| Output Rate             | Output rate in bps and pps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | None specified        |
| Statistics last cleared | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | detail extensive      |
| Traffic statistics      | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> <p>Gigabit Ethernet and 10-Gigabit Ethernet IQ PICs count the overhead and CRC bytes.</p> <p>For Gigabit Ethernet IQ PICs, the input byte counts vary by interface type. For more information, see Table 31 under the <a href="#">show interfaces (10-Gigabit Ethernet)</a> command.</p> | detail extensive      |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name          | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Level of Output  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Input errors</b> | <p>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>L3 incompletes</b>—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. L3 incomplete errors can be ignored by configuring the <b>ignore-l3-incompletes</b> statement.</li> <li>• <b>L2 channel errors</b>—Number of times the software did not find a valid logical interface for an incoming frame.</li> <li>• <b>L2 mismatch timeouts</b>—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b> |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output         |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Output errors</b>           | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Collisions</b>—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug.</li> <li>• <b>Aged packets</b>—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>HS link CRC errors</b>—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>        |
| <b>Egress queues</b>           | <p>Total number of egress queues supported on the specified interface.</p> <p><b>NOTE:</b> In DPCs that are not of the enhanced type, such as DPC 40x1GE R, DPCE 20x1GE + 2x10GE R, or DPCE 40x1GE R, you might notice a discrepancy in the output of the <b>show interfaces</b> command because incoming packets might be counted in the Egress queues section of the output. This problem occurs on non-enhanced DPCs because the egress queue statistics are polled from IMQ (Inbound Message Queuing) block of the I-chip. The IMQ block does not differentiate between ingress and egress WAN traffic; as a result, the combined statistics are displayed in the egress queue counters on the Routing Engine. In a simple VPLS scenario, if there is no MAC entry in DMAC table (by sending unidirectional traffic), traffic is flooded and the input traffic is accounted in IMQ. For bidirectional traffic (MAC entry in DMAC table), if the outgoing interface is on the same I-chip then both ingress and egress statistics are counted in a combined way. If the outgoing interface is on a different I-chip or FPC, then only egress statistics are accounted in IMQ. This behavior is expected with non-enhanced DPCs</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b> |
| <b>Queue counters (Egress)</b> | <p>CoS queue number and its associated user-configured forwarding class name.</p> <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive</b> |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                              | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Level of Output              |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Ingress queues</b>                   | Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>extensive</b>             |
| <b>Queue counters (Ingress)</b>         | CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces. <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul>                                                                                                                                                                                                                                                                                                                               | <b>extensive</b>             |
| <b>Active alarms and Active defects</b> | Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the routing device configuration, an alarm can ring the red or yellow alarm bell on the routing device, or turn on the red or yellow alarm LED on the craft interface. These fields can contain the value <b>None</b> or <b>Link</b> . <ul style="list-style-type: none"> <li>• <b>None</b>—There are no active defects or alarms.</li> <li>• <b>Link</b>—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.</li> </ul> | <b>detail extensive none</b> |
| <b>OTN FEC statistics</b>               | The forward error correction (FEC) counters provide the following statistics: <ul style="list-style-type: none"> <li>• <b>Corrected Errors</b>—The count of corrected errors in the last second.</li> <li>• <b>Corrected Error Ratio</b>—The corrected error ratio in the last 25 seconds. For example, 1e-7 is 1 error per 10 million bits.</li> </ul>                                                                                                                                                                                                                                                                                                                                                 |                              |
| <b>PCS statistics</b>                   | (10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device. <ul style="list-style-type: none"> <li>• <b>Bit errors</b>—The number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.</li> <li>• <b>Errored blocks</b>—The number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.</li> </ul>                                                                                                                                                                                                           | <b>detail extensive</b>      |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Level of Output |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| MAC statistics                 | <p>Receive and Transmit statistics reported by the PIC's MAC subsystem, including the following:</p> <ul style="list-style-type: none"> <li>• <b>Total octets</b> and <b>total packets</b>—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. For more information, see Table 31 under the <a href="#">show interfaces (10-Gigabit Ethernet)</a> command.</li> <li>• <b>Unicast packets</b>, <b>Broadcast packets</b>, and <b>Multicast packets</b>—Number of unicast, broadcast, and multicast packets.</li> <li>• <b>CRC/Align errors</b>—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error).</li> <li>• <b>FIFO error</b>—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC or a cable is probably malfunctioning.</li> <li>• <b>MAC control frames</b>—Number of MAC control frames.</li> <li>• <b>MAC pause frames</b>—Number of MAC control frames with <b>pause</b> operational code.</li> <li>• <b>Oversized frames</b>—Number of frames that exceed 1518 octets.</li> <li>• <b>Jabber frames</b>—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms.</li> <li>• <b>Fragment frames</b>—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. Fragment frames normally increment because both runts (which are normal occurrences caused by collisions) and noise hits are counted.</li> <li>• <b>VLAN tagged frames</b>—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not.</li> <li>• <b>Code violations</b>—Number of times an event caused the PHY to indicate "Data reception error" or "invalid data symbol error."</li> </ul> | extensive       |
| OTN Received Overhead Bytes    | APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | extensive       |
| OTN Transmitted Overhead Bytes | APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | extensive       |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output  |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Filter statistics</b> | <p><b>Receive</b> and <b>Transmit</b> statistics reported by the PIC's MAC address filter subsystem. The filtering is done by the content-addressable memory (CAM) on the PIC. The filter examines a packet's source and destination MAC addresses to determine whether the packet should enter the system or be rejected.</p> <ul style="list-style-type: none"> <li>• <b>Input packet count</b>—Number of packets received from the MAC hardware that the filter processed.</li> <li>• <b>Input packet rejects</b>—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</li> <li>• <b>Input DA rejects</b>—Number of packets that the filter rejected because the destination MAC address of the packet is not on the accept list. It is normal for this value to increment. When it increments very quickly and no traffic is entering the routing device from the far-end system, either there is a bad ARP entry on the far-end system, or multicast routing is not on and the far-end system is sending many multicast packets to the local routing device (which the routing device is rejecting).</li> <li>• <b>Input SA rejects</b>—Number of packets that the filter rejected because the source MAC address of the packet is not on the accept list. The value in this field should increment only if source MAC address filtering has been enabled. If filtering is enabled, if the value increments quickly, and if the system is not receiving traffic that it should from the far-end system, it means that the user-configured source MAC addresses for this interface are incorrect.</li> <li>• <b>Output packet count</b>—Number of packets that the filter has given to the MAC hardware.</li> <li>• <b>Output packet pad count</b>—Number of packets the filter padded to the minimum Ethernet size (60 bytes) before giving the packet to the MAC hardware. Usually, padding is done only on small ARP packets, but some very small IP packets can also require padding. If this value increments rapidly, either the system is trying to find an ARP entry for a far-end system that does not exist or it is misconfigured.</li> <li>• <b>Output packet error count</b>—Number of packets with an indicated error that the filter was given to transmit. These packets are usually aged packets or are the result of a bandwidth problem on the FPC hardware. On a normal system, the value of this field should not increment.</li> <li>• <b>CAM destination filters, CAM source filters</b>—Number of entries in the CAM dedicated to destination and source MAC address filters. There can only be up to 64 source entries. If source filtering is disabled, which is the default, the values for these fields should be 0.</li> </ul> | <b>extensive</b> |
| <b>PMA PHY</b>           | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>PHY Lock</b>—Phase-locked loop</li> <li>• <b>PHY Light</b>—Loss of optical signal</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>extensive</b> |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name         | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Level of Output  |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS section</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B1</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>SEF</b>—Severely errored framing</li> <li>• <b>LOL</b>—Loss of light</li> <li>• <b>LOF</b>—Loss of frame</li> <li>• <b>ES-S</b>—Errored seconds (section)</li> <li>• <b>SES-S</b>—Severely errored seconds (section)</li> <li>• <b>SEFS-S</b>—Severely errored framing seconds (section)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>extensive</b> |
| <b>WIS line</b>    | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. State other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B2</b>—Bit interleaved parity for SONET line overhead</li> <li>• <b>REI-L</b>—Remote error indication (near-end line)</li> <li>• <b>RDI-L</b>—Remote defect indication (near-end line)</li> <li>• <b>AIS-L</b>—Alarm indication signal (near-end line)</li> <li>• <b>BERR-SF</b>—Bit error rate fault (signal failure)</li> <li>• <b>BERR-SD</b>—Bit error rate defect (signal degradation)</li> <li>• <b>ES-L</b>—Errored seconds (near-end line)</li> <li>• <b>SES-L</b>—Severely errored seconds (near-end line)</li> <li>• <b>UAS-L</b>—Unavailable seconds (near-end line)</li> <li>• <b>ES-LFE</b>—Errored seconds (far-end line)</li> <li>• <b>SES-LFE</b>—Severely errored seconds (far-end line)</li> <li>• <b>UAS-LFE</b>—Unavailable seconds (far-end line)</li> </ul> | <b>extensive</b> |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Level of Output  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS path</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B3</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>REI-P</b>—Remote error indication</li> <li>• <b>LOP-P</b>—Loss of pointer (path)</li> <li>• <b>AIS-P</b>—Path alarm indication signal</li> <li>• <b>RDI-P</b>—Path remote defect indication</li> <li>• <b>UNEQ-P</b>—Path unequipped</li> <li>• <b>PLM-P</b>—Path payload (signal) label mismatch</li> <li>• <b>ES-P</b>—Errored seconds (near-end STS path)</li> <li>• <b>SES-P</b>—Severely errored seconds (near-end STS path)</li> <li>• <b>UAS-P</b>—Unavailable seconds (near-end STS path)</li> <li>• <b>SES-PFE</b>—Severely errored seconds (far-end STS path)</li> <li>• <b>UAS-PFE</b>—Unavailable seconds (far-end STS path)</li> </ul> | <b>extensive</b> |



Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                                  | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Autonegotiation information                 | <p>Information about link autonegotiation.</p> <ul style="list-style-type: none"> <li>• <b>Negotiation status:</b> <ul style="list-style-type: none"> <li>• <b>Incomplete</b>—Ethernet interface has the speed or link mode configured.</li> <li>• <b>No autonegotiation</b>—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.</li> <li>• <b>Complete</b>—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> </ul> </li> <li>• <b>Link partner status</b>—OK when Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> <li>• <b>Link partner:</b> <ul style="list-style-type: none"> <li>• <b>Link mode</b>—Depending on the capability of the attached Ethernet device, either <b>Full-duplex</b> or <b>Half-duplex</b>.</li> <li>• <b>Flow control</b>—Types of flow control supported by the remote Ethernet device. For Fast Ethernet interfaces, the type is <b>None</b>. For Gigabit Ethernet interfaces, types are <b>Symmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (link partner supports <b>PAUSE</b> on transmit), and <b>Symmetric/Asymmetric</b> (link partner supports both <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> receive).</li> <li>• <b>Remote fault</b>—Remote fault information from the link partner—<b>Failure</b> indicates a receive link error. <b>OK</b> indicates that the link partner is receiving. <b>Negotiation error</b> indicates a negotiation error. <b>Offline</b> indicates that the link partner is going offline.</li> </ul> </li> <li>• <b>Local resolution</b>—Information from the link partner: <ul style="list-style-type: none"> <li>• <b>Flow control</b>—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are <b>Symmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (link partner supports <b>PAUSE</b> on transmit), and <b>Symmetric/Asymmetric</b> (link partner supports both <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> receive).</li> <li>• <b>Remote fault</b>—Remote fault information. <b>Link OK</b> (no error detected on receive), <b>Offline</b> (local interface is offline), and <b>Link Failure</b> (link error detected on receive).</li> </ul> </li> </ul> | extensive       |
| Received path trace, Transmitted path trace | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other routing device manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the routing device at the other end of the fiber. The transmitted path trace value is the message that this routing device transmits.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | extensive       |
| Packet Forwarding Engine configuration      | <p>Information about the configuration of the Packet Forwarding Engine:</p> <ul style="list-style-type: none"> <li>• <b>Destination slot</b>—FPC slot number.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | extensive       |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Level of Output                    |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>CoS information</b>   | Information about the CoS queue for the physical interface. <ul style="list-style-type: none"> <li>• <b>CoS transmit queue</b>—Queue number and its associated user-configured forwarding class name.</li> <li>• <b>Bandwidth %</b>—Percentage of bandwidth allocated to the queue.</li> <li>• <b>Bandwidth bps</b>—Bandwidth allocated to the queue (in bps).</li> <li>• <b>Buffer %</b>—Percentage of buffer space allocated to the queue.</li> <li>• <b>Buffer usec</b>—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time.</li> <li>• <b>Priority</b>—Queue priority: <b>low</b> or <b>high</b>.</li> <li>• <b>Limit</b>—Displayed if rate limiting is configured for the queue. Possible values are <b>none</b> and <b>exact</b>. If <b>exact</b> is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If <b>none</b> is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.</li> </ul>                                                                                                                                                                                                                                                                                                                                                            | <b>extensive</b>                   |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                    |
| <b>Logical interface</b> | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All levels                         |
| <b>Index</b>             | Index number of the logical interface, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b> none       |
| <b>SNMP ifIndex</b>      | SNMP interface index number for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b> none       |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b>            |
| <b>Flags</b>             | Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | All levels                         |
| <b>VLAN-Tag</b>          | Rewrite profile applied to incoming or outgoing frames on the outer ( <b>Out</b> ) VLAN tag or for both the outer and inner ( <b>In</b> ) VLAN tags. <ul style="list-style-type: none"> <li>• <b>push</b>—An outer VLAN tag is pushed in front of the existing VLAN tag.</li> <li>• <b>pop</b>—The outer VLAN tag of the incoming frame is removed.</li> <li>• <b>swap</b>—The outer VLAN tag of the incoming frame is overwritten with the user specified VLAN tag information.</li> <li>• <b>push-pop</b>—An outer VLAN tag is pushed in front of the existing VLAN tag, and the outer VLAN tag of the incoming frame is removed.</li> <li>• <b>push-push</b>—Two VLAN tags are pushed in from the incoming frame.</li> <li>• <b>swap-push</b>—The outer VLAN tag of the incoming frame is replaced by a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.</li> <li>• <b>swap-swap</b>—Both the inner and the outer VLAN tags of the incoming frame are replaced by the user specified VLAN tag value.</li> <li>• <b>pop-swap</b>—The outer VLAN tag of the incoming frame is removed, and the inner VLAN tag of the incoming frame is replaced by the user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.</li> <li>• <b>pop-pop</b>—Both the outer and inner VLAN tags of the incoming frame are removed.</li> </ul> | <b>brief detail extensive</b> none |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level of Output              |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Demux:</b>                  | IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following: <ul style="list-style-type: none"> <li>Source Family Inet</li> <li>Destination Family Inet</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Encapsulation</b>           | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | All levels                   |
| <b>Protocol</b>                | Protocol family. Possible values are described in the “Protocol Field” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>detail extensive none</b> |
| <b>MTU</b>                     | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Maximum labels</b>          | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive none</b> |
| <b>Traffic statistics</b>      | Number and rate of bytes and packets received and transmitted on the specified interface set. <ul style="list-style-type: none"> <li><b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the interface set</li> <li><b>Input packets, Output packets</b>—Number of packets received and transmitted on the interface set.</li> </ul>                                                                                                                                                                                                                                                                                                    | <b>detail extensive</b>      |
| <b>IPv6 transit statistics</b> | Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>extensive</b>             |
| <b>Local statistics</b>        | Number and rate of bytes and packets destined to the routing device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>extensive</b>             |
| <b>Transit statistics</b>      | Number and rate of bytes and packets transiting the switch. <p><b>NOTE:</b> For Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces, the logical interface egress statistics might not accurately reflect the traffic on the wire when output shaping is applied. Traffic management output shaping might drop packets after they are tallied by the <b>Output bytes</b> and <b>Output packets</b> interface counters. However, correct values display for both of these egress statistics when per-unit scheduling is enabled for the Gigabit Ethernet IQ2 physical interface, or when a single logical interface is actively using a shared scheduler.</p> | <b>extensive</b>             |
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b>      |
| <b>Route Table</b>             | Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive none</b> |
| <b>Flags</b>                   | Information about protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b>      |
| <b>Donor interface</b>         | (Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b> |

Table 98: show interfaces Fast Ethernet Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                    | Level of Output              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Preferred source address</b> | (Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.                                        | <b>detail extensive none</b> |
| <b>Input Filters</b>            | Names of any input filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parenthesis next to all interfaces.  | <b>detail extensive</b>      |
| <b>Output Filters</b>           | Names of any output filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parenthesis next to all interfaces. | <b>detail extensive</b>      |
| <b>Mac-Validate Failures</b>    | Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.                                           | <b>detail extensive none</b> |
| <b>Addresses, Flags</b>         | Information about the address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                                                  | <b>detail extensive none</b> |
| <b><i>protocol-family</i></b>   | Protocol family configured on the logical interface. If the protocol is <b>inet</b> , the IP address of the interface is also displayed.                                                             | <b>brief</b>                 |
| <b>Flags</b>                    | Information about address flag (possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> ).                                                      | <b>detail extensive none</b> |
| <b>Destination</b>              | IP address of the remote side of the connection.                                                                                                                                                     | <b>detail extensive none</b> |
| <b>Local</b>                    | IP address of the logical interface.                                                                                                                                                                 | <b>detail extensive none</b> |
| <b>Broadcast</b>                | Broadcast address of the logical interface.                                                                                                                                                          | <b>detail extensive none</b> |
| <b>Generation</b>               | Unique number for use by Juniper Networks technical support only.                                                                                                                                    | <b>detail extensive</b>      |

## Sample Output

### show interfaces (Fast Ethernet)

```

user@host> show interfaces fe-0/0/0
Physical interface: fe-0/0/0, Enabled, Physical link is Up
  Interface index: 128, SNMP ifIndex: 22
  Link-level type: Ethernet, MTU: 1514, Speed: 100mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  CoS queues     : 4 supported, 4 maximum usable queues
  Current address: 00:05:85:02:38:00, Hardware address: 00:05:85:02:38:00
  Last flapped   : 2006-01-20 14:50:58 PST (2w4d 00:44 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None
  Logical interface fe-0/0/0.0 (Index 66) (SNMP ifIndex 198)
    Flags: SNMP-Traps Encapsulation: ENET2

```

```

Protocol inet, MTU: 1500
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255

```

### show interfaces brief (Fast Ethernet)

```

user@host> show interfaces fe-0/0/0 brief
Physical interface: fe-0/0/0, Enabled, Physical link is Up
Link-level type: Ethernet, MTU: 1514, Speed: 100mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Logical interface fe-0/0/0.0
Flags: SNMP-Traps Encapsulation: ENET2
inet 10.10.10.1/24

```

### show interfaces detail (Fast Ethernet)

```

user@host> show interfaces fe-0/0/0 detail
Physical interface: fe-0/0/0, Enabled, Physical link is Up
Interface index: 128, SNMP ifIndex: 22, Generation: 5391
Link-level type: Ethernet, MTU: 1514, Speed: 100mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
CoS queues : 4 supported, 4 maximum usable queues
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:05:85:02:38:00, Hardware address: 00:05:85:02:38:00
Last flapped : 2006-01-20 14:50:58 PST (2w4d 00:45 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes : 0 0 bps
Output bytes : 42 0 bps
Input packets: 0 0 pps
Output packets: 1 0 pps
Active alarms : None
Active defects : None
Logical interface fe-0/0/0.0 (Index 66) (SNMP ifIndex 198) (Generation 67)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500, Generation: 105, Route table: 0
Flags: Is-Primary, Mac-Validate-Strict
Mac-Validate Failures: Packets: 0, Bytes: 0
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255,
Generation: 136

```

### show interfaces extensive (Fast Ethernet)

```

user@host> show interfaces fe-0/0/0 extensive
Physical interface: fe-0/0/0, Enabled, Physical link is Up
Interface index: 128, SNMP ifIndex: 22, Generation: 5391
Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, Speed:
100mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
CoS queues : 4 supported, 4 maximum usable queues
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:05:85:02:38:00, Hardware address: 00:05:85:02:38:00
Last flapped : 2006-01-20 14:50:58 PST (2w4d 00:46 ago)
Statistics last cleared: Never

```

```

Traffic statistics:
Input bytes :          0          0 bps
Output bytes :         42          0 bps
Input packets:         0          0 pps
Output packets:        1          0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  FIFO errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 3, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Active alarms : None
Active defects : None
MAC statistics:
Total octets          Receive      Transmit
Total packets         0            1
Unicast packets       0            0
Broadcast packets     0            1
Multicast packets     0            0
CRC/Align errors      0            0
FIFO errors           0            0
MAC control frames    0            0
MAC pause frames      0            0
Oversized frames      0
Jabber frames         0
Fragment frames       0
VLAN tagged frames    0
Code violations        0
Filter statistics:
Input packet count    0
Input packet rejects  0
Input DA rejects      0
Input SA rejects      0
Output packet count   1
Output packet pad count 0
Output packet error count 0
CAM destination filters: 1, CAM source filters: 0
Autonegotiation information:
Negotiation status: Complete
Link partner:
  Link partner: Full-duplex, Flow control: None, Remote fault: Ok
Local resolution:
Packet Forwarding Engine configuration:
Destination slot: 0
CoS information:
      Bandwidth      Buffer Priority  Limit
      %             bps  %         usec
0 best-effort      95   950000000  95         0    low  none
3 network-control  5   500000000   5         0    low  none
Logical interface fe-0/0/0.0 (Index 66) (SNMP ifIndex 198) (Generation 67)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500, Generation: 105, Route table: 0
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255,
Generation: 136

```

## show interfaces (Gigabit Ethernet)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces <i>ge-fpc/pic/port</i> &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Display status information about the specified Gigabit Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Options</b>                  | <p><b><i>ge-fpc/pic/port</i></b>—Display standard information about the specified Gigabit Ethernet interface.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p>                                                                                                                                                             |
| <b>Additional Information</b>   | In a logical system, this command displays information only about the logical interfaces and not about the physical interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces (Gigabit Ethernet) on page 1595</a></p> <p><a href="#">show interfaces (Gigabit Ethernet on MX Series Routers) on page 1596</a></p> <p><a href="#">show interfaces extensive (Gigabit Ethernet on MX Series Routers showing interface transmit statistics configuration) on page 1596</a></p> <p><a href="#">show interfaces brief (Gigabit Ethernet) on page 1596</a></p> <p><a href="#">show interfaces detail (Gigabit Ethernet) on page 1597</a></p> <p><a href="#">show interfaces extensive (Gigabit Ethernet IQ2) on page 1598</a></p> <p><a href="#">show interfaces (Gigabit Ethernet Unnumbered Interface) on page 1601</a></p> <p><a href="#">show interfaces (ACI Interface Set Configured) on page 1602</a></p> |
| <b>Output Fields</b>            | <p><a href="#">Table 99 on page 1580</a> describes the output fields for the <b>show interfaces</b> (Gigabit Ethernet) command. Output fields are listed in the approximate order in which they appear. For Gigabit Ethernet IQ and IQE PICs, the traffic and MAC statistics vary by interface type. For more information, see <a href="#">Table 100 on page 1594</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                  |

Table 99: show interfaces (Gigabit Ethernet) Output Fields

| Field Name                | Field Description                                                                                                                                                                                                                                   | Level of Output              |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Physical Interface</b> |                                                                                                                                                                                                                                                     |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                                                                                                                                     | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .                                                                                                                | All levels                   |
| <b>Interface index</b>    | Index number of the physical interface, which reflects its initialization sequence.                                                                                                                                                                 | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                                                                                                                                       | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                   | <b>detail extensive</b>      |
| <b>Link-level type</b>    | Encapsulation being used on the physical interface.                                                                                                                                                                                                 | All levels                   |
| <b>MTU</b>                | Maximum transmission unit size on the physical interface.                                                                                                                                                                                           | All levels                   |
| <b>Speed</b>              | Speed at which the interface is running.                                                                                                                                                                                                            | All levels                   |
| <b>Loopback</b>           | Loopback status: <b>Enabled</b> or <b>Disabled</b> . If loopback is enabled, type of loopback: <b>Local</b> or <b>Remote</b> .                                                                                                                      | All levels                   |
| <b>Source filtering</b>   | Source filtering status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                        | All levels                   |
| <b>LAN-PHY mode</b>       | 10-Gigabit Ethernet interface operating in Local Area Network Physical Layer Device (LAN PHY) mode. LAN PHY allows 10-Gigabit Ethernet wide area links to use existing Ethernet applications.                                                       | All levels                   |
| <b>WAN-PHY mode</b>       | 10-Gigabit Ethernet interface operating in Wide Area Network Physical Layer Device (WAN PHY) mode. WAN PHY allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and other devices intended for SONET/SDH.                           | All levels                   |
| <b>Unidirectional</b>     | Unidirectional link mode status for 10-Gigabit Ethernet interface: <b>Enabled</b> or <b>Disabled</b> for parent interface; <b>Rx-only</b> or <b>Tx-only</b> for child interfaces.                                                                   | All levels                   |
| <b>Flow control</b>       | Flow control status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                            | All levels                   |
| <b>Auto-negotiation</b>   | (Gigabit Ethernet interfaces) Autonegotiation status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                           | All levels                   |
| <b>Remote-fault</b>       | (Gigabit Ethernet interfaces) Remote fault status: <ul style="list-style-type: none"> <li>• <b>Online</b>—Autonegotiation is manually configured as online.</li> <li>• <b>Offline</b>—Autonegotiation is manually configured as offline.</li> </ul> | All levels                   |
| <b>Device flags</b>       | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                  | All levels                   |
| <b>Interface flags</b>    | Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                     | All levels                   |



Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                                                                                           | Level of Output              |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Link flags</b>               | Information about the link. Possible values are described in the “Links Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                      | All levels                   |
| <b>Wavelength</b>               | (10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).                                                                                                                                      | All levels                   |
| <b>Frequency</b>                | (10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).                                                                                                                                            | All levels                   |
| <b>CoS queues</b>               | Number of CoS queues configured.                                                                                                                                                                                                                                            | <b>detail extensive</b> none |
| <b>Schedulers</b>               | (Gigabit Ethernet intelligent queuing 2 [IQ2] interfaces only) Number of CoS schedulers configured.                                                                                                                                                                         | <b>extensive</b>             |
| <b>Hold-times</b>               | Current interface hold-time up and hold-time down, in milliseconds (ms).                                                                                                                                                                                                    | <b>detail extensive</b>      |
| <b>Current address</b>          | Configured MAC address.                                                                                                                                                                                                                                                     | <b>detail extensive</b> none |
| <b>Hardware address</b>         | Hardware MAC address.                                                                                                                                                                                                                                                       | <b>detail extensive</b> none |
| <b>Last flapped</b>             | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> .                        | <b>detail extensive</b> none |
| <b>Input Rate</b>               | Input rate in bits per second (bps) and packets per second (pps). The value in this field also includes the Layer 2 overhead bytes for ingress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level. | None                         |
| <b>Output Rate</b>              | Output rate in bps and pps. The value in this field also includes the Layer 2 overhead bytes for egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.                                        | None                         |
| <b>Statistics last cleared</b>  | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                           | <b>detail extensive</b>      |
| <b>Egress account overhead</b>  | Layer 2 overhead in bytes that is accounted in the interface statistics for egress traffic.                                                                                                                                                                                 | <b>detail extensive</b>      |
| <b>Ingress account overhead</b> | Layer 2 overhead in bytes that is accounted in the interface statistics for ingress traffic.                                                                                                                                                                                | <b>detail extensive</b>      |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output         |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Traffic statistics</b> | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface. The value in this field also includes the Layer 2 overhead bytes for ingress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface. The value in this field also includes the Layer 2 overhead bytes for egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> <p>Gigabit Ethernet and 10-Gigabit Ethernet IQ PICs count the overhead and CRC bytes.</p> <p>For Gigabit Ethernet IQ PICs, the input byte counts vary by interface type. For more information, see Table 31 under the <a href="#">show interfaces (10-Gigabit Ethernet)</a> command.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b> |
| <b>Input errors</b>       | <p>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle.</li> <li>• <b>L3 incompletes</b>—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. L3 incomplete errors can be ignored by configuring the <b>ignore-l3-incompletes</b> statement.</li> <li>• <b>L2 channel errors</b>—Number of times the software did not find a valid logical interface for an incoming frame.</li> <li>• <b>L2 mismatch timeouts</b>—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>        |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name           | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output         |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Output errors</b> | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> </ul> <p><b>NOTE:</b> Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the <b>Drops</b> field does not always use the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p> <ul style="list-style-type: none"> <li>• <b>Collisions</b>—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug.</li> <li>• <b>Aged packets</b>—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>HS link CRC errors</b>—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>        |
| <b>Egress queues</b> | <p>Total number of egress queues supported on the specified interface.</p> <p><b>NOTE:</b> In DPCs that are not of the enhanced type, such as DPC 40x 1GER, DPCE 20x 1GE + 2x 10GE R, or DPCE 40x 1GE R, you might notice a discrepancy in the output of the <b>show interfaces</b> command because incoming packets might be counted in the Egress queues section of the output. This problem occurs on non-enhanced DPCs because the egress queue statistics are polled from IMQ (Inbound Message Queuing) block of the I-chip. The IMQ block does not differentiate between ingress and egress WAN traffic; as a result, the combined statistics are displayed in the egress queue counters on the Routing Engine. In a simple VPLS scenario, if there is no MAC entry in DMAC table (by sending unidirectional traffic), traffic is flooded and the input traffic is accounted in IMQ. For bidirectional traffic (MAC entry in DMAC table), if the outgoing interface is on the same I-chip then both ingress and egress statistics are counted in a combined way. If the outgoing interface is on a different I-chip or FPC, then only egress statistics are accounted in IMQ. This behavior is expected with non-enhanced DPCs</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive</b> |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output       |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Queue counters (Egress)          | <p>CoS queue number and its associated user-configured forwarding class name.</p> <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul> <p><b>NOTE:</b> Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the <b>Dropped packets</b> field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</p>                                                       | detail extensive      |
| Ingress queues                   | Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | extensive             |
| Queue counters (Ingress)         | <p>CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces.</p> <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul>                                                                                                                                                                                                                                                                                                              | extensive             |
| Active alarms and Active defects | <p>Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the router configuration, an alarm can ring the red or yellow alarm bell on the router, or turn on the red or yellow alarm LED on the craft interface. These fields can contain the value <b>None</b> or <b>Link</b>.</p> <ul style="list-style-type: none"> <li>• <b>None</b>—There are no active defects or alarms.</li> <li>• <b>Link</b>—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.</li> </ul> | detail extensive none |
| Interface transmit statistics    | <p>(On MX Series devices) Status of the <b>interface-transmit-statistics</b> configuration: Enabled or Disabled.</p> <ul style="list-style-type: none"> <li>• <b>Enabled</b>—When the <b>interface-transmit-statistics</b> statement is included in the configuration. If this is configured, the interface statistics show the actual transmitted load on the interface.</li> <li>• <b>Disabled</b>—When the <b>interface-transmit-statistics</b> statement is not included in the configuration. If this is not configured, the interface statistics show the offered load on the interface.</li> </ul>                                                                                     | detail extensive      |
| OTN FEC statistics               | <p>The forward error correction (FEC) counters provide the following statistics:</p> <ul style="list-style-type: none"> <li>• <b>Corrected Errors</b>—Count of corrected errors in the last second.</li> <li>• <b>Corrected Error Ratio</b>—Corrected error ratio in the last 25 seconds. For example, 1e-7 is 1 error per 10 million bits.</li> </ul>                                                                                                                                                                                                                                                                                                                                        | detail extensive      |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name            | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Level of Output         |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>PCS statistics</b> | (10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device. <ul style="list-style-type: none"><li>• <b>Bit errors</b>—Number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.</li><li>• <b>Errored blocks</b>—Number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.</li></ul> | <b>detail extensive</b> |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Level of Output |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| MAC statistics                 | <p>Receive and Transmit statistics reported by the PIC's MAC subsystem, including the following:</p> <ul style="list-style-type: none"> <li>• <b>Total octets</b> and <b>total packets</b>—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. For more information, see Table 31 under the <a href="#">show interfaces (10-Gigabit Ethernet)</a> command.</li> <li>• <b>Unicast packets</b>, <b>Broadcast packets</b>, and <b>Multicast packets</b>—Number of unicast, broadcast, and multicast packets.</li> <li>• <b>CRC/Align errors</b>—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error).</li> <li>• <b>FIFO error</b>—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC or a cable is probably malfunctioning.</li> <li>• <b>MAC control frames</b>—Number of MAC control frames.</li> <li>• <b>MAC pause frames</b>—Number of MAC control frames with <b>pause</b> operational code.</li> <li>• <b>Oversized frames</b>—There are two possible conditions regarding the number of oversized frames: <ul style="list-style-type: none"> <li>• Packet length exceeds 1518 octets, or</li> <li>• Packet length exceeds MRU</li> </ul> </li> <li>• <b>Jabber frames</b>—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms.</li> <li>• <b>Fragment frames</b>—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS error or an alignment error. Fragment frames normally increment because both runs (which are normal occurrences caused by collisions) and noise hits are counted.</li> <li>• <b>VLAN tagged frames</b>—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not. <p><b>NOTE:</b> The 20-port Gigabit Ethernet MIC (MIC-3D-20GE-SFP) does not have hardware counters for VLAN frames. Therefore, the <b>VLAN tagged frames</b> field displays 0 when the <b>show interfaces</b> command is executed on a 20-port Gigabit Ethernet MIC. In other words, the number of VLAN tagged frames cannot be determined for the 20-port Gigabit Ethernet MIC.</p> </li> <li>• <b>Code violations</b>—Number of times an event caused the PHY to indicate "Data reception error" or "invalid data symbol error."</li> </ul> | extensive       |
| OTN Received Overhead Bytes    | APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | extensive       |
| OTN Transmitted Overhead Bytes | APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | extensive       |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name        | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Level of Output |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Filter statistics | <p>Receive and Transmit statistics reported by the PIC's MAC address filter subsystem. The filtering is done by the content-addressable memory (CAM) on the PIC. The filter examines a packet's source and destination MAC addresses to determine whether the packet should enter the system or be rejected.</p> <ul style="list-style-type: none"> <li>• <b>Input packet count</b>—Number of packets received from the MAC hardware that the filter processed.</li> <li>• <b>Input packet rejects</b>—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</li> <li>• <b>Input DA rejects</b>—Number of packets that the filter rejected because the destination MAC address of the packet is not on the accept list. It is normal for this value to increment. When it increments very quickly and no traffic is entering the router from the far-end system, either there is a bad ARP entry on the far-end system, or multicast routing is not on and the far-end system is sending many multicast packets to the local router (which the router is rejecting).</li> <li>• <b>Input SA rejects</b>—Number of packets that the filter rejected because the source MAC address of the packet is not on the accept list. The value in this field should increment only if source MAC address filtering has been enabled. If filtering is enabled, if the value increments quickly, and if the system is not receiving traffic that it should from the far-end system, it means that the user-configured source MAC addresses for this interface are incorrect.</li> <li>• <b>Output packet count</b>—Number of packets that the filter has given to the MAC hardware.</li> <li>• <b>Output packet pad count</b>—Number of packets the filter padded to the minimum Ethernet size (60 bytes) before giving the packet to the MAC hardware. Usually, padding is done only on small ARP packets, but some very small IP packets can also require padding. If this value increments rapidly, either the system is trying to find an ARP entry for a far-end system that does not exist or it is misconfigured.</li> <li>• <b>Output packet error count</b>—Number of packets with an indicated error that the filter was given to transmit. These packets are usually aged packets or are the result of a bandwidth problem on the FPC hardware. On a normal system, the value of this field should not increment.</li> <li>• <b>CAM destination filters, CAM source filters</b>—Number of entries in the CAM dedicated to destination and source MAC address filters. There can only be up to 64 source entries. If source filtering is disabled, which is the default, the values for these fields should be 0.</li> </ul> | extensive       |
| PMA PHY           | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>PHY Lock</b>—Phase-locked loop</li> <li>• <b>PHY Light</b>—Loss of optical signal</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | extensive       |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name         | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Level of Output  |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS section</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B1</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>SEF</b>—Severely errored framing</li> <li>• <b>LOL</b>—Loss of light</li> <li>• <b>LOF</b>—Loss of frame</li> <li>• <b>ES-S</b>—Errored seconds (section)</li> <li>• <b>SES-S</b>—Severely errored seconds (section)</li> <li>• <b>SEFS-S</b>—Severely errored framing seconds (section)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>extensive</b> |
| <b>WIS line</b>    | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B2</b>—Bit interleaved parity for SONET line overhead</li> <li>• <b>REI-L</b>—Remote error indication (near-end line)</li> <li>• <b>RDI-L</b>—Remote defect indication (near-end line)</li> <li>• <b>AIS-L</b>—Alarm indication signal (near-end line)</li> <li>• <b>BERR-SF</b>—Bit error rate fault (signal failure)</li> <li>• <b>BERR-SD</b>—Bit error rate defect (signal degradation)</li> <li>• <b>ES-L</b>—Errored seconds (near-end line)</li> <li>• <b>SES-L</b>—Severely errored seconds (near-end line)</li> <li>• <b>UAS-L</b>—Unavailable seconds (near-end line)</li> <li>• <b>ES-LFE</b>—Errored seconds (far-end line)</li> <li>• <b>SES-LFE</b>—Severely errored seconds (far-end line)</li> <li>• <b>UAS-LFE</b>—Unavailable seconds (far-end line)</li> </ul> | <b>extensive</b> |



Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Level of Output  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS path</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B3</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>REI-P</b>—Remote error indication</li> <li>• <b>LOP-P</b>—Loss of pointer (path)</li> <li>• <b>AIS-P</b>—Path alarm indication signal</li> <li>• <b>RDI-P</b>—Path remote defect indication</li> <li>• <b>UNEQ-P</b>—Path unequipped</li> <li>• <b>PLM-P</b>—Path payload (signal) label mismatch</li> <li>• <b>ES-P</b>—Errored seconds (near-end STS path)</li> <li>• <b>SES-P</b>—Severely errored seconds (near-end STS path)</li> <li>• <b>UAS-P</b>—Unavailable seconds (near-end STS path)</li> <li>• <b>SES-PFE</b>—Severely errored seconds (far-end STS path)</li> <li>• <b>UAS-PFE</b>—Unavailable seconds (far-end STS path)</li> </ul> | <b>extensive</b> |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                                  | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Level of Output |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Autonegotiation information                 | <p>Information about link autonegotiation.</p> <ul style="list-style-type: none"> <li>• <b>Negotiation status:</b> <ul style="list-style-type: none"> <li>• <b>Incomplete</b>—Ethernet interface has the speed or link mode configured.</li> <li>• <b>No autonegotiation</b>—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.</li> <li>• <b>Complete</b>—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> </ul> </li> <li>• <b>Link partner status</b>—OK when Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> <li>• <b>Link partner</b>—Information from the remote Ethernet device: <ul style="list-style-type: none"> <li>• <b>Link mode</b>—Depending on the capability of the link partner, either <b>Full-duplex</b> or <b>Half-duplex</b>.</li> <li>• <b>Flow control</b>—Types of flow control supported by the link partner. For Gigabit Ethernet interfaces, types are <b>Symmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (link partner supports <b>PAUSE</b> on transmit), <b>Symmetric/Asymmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> on transmit), and <b>None</b> (link partner does not support flow control).</li> <li>• <b>Remote fault</b>—Remote fault information from the link partner—<b>Failure</b> indicates a receive link error. <b>OK</b> indicates that the link partner is receiving. <b>Negotiation error</b> indicates a negotiation error. <b>Offline</b> indicates that the link partner is going offline.</li> </ul> </li> <li>• <b>Local resolution</b>—Information from the local Ethernet device: <ul style="list-style-type: none"> <li>• <b>Flow control</b>—Types of flow control supported by the local device. For Gigabit Ethernet interfaces, advertised capabilities are <b>Symmetric/Asymmetric</b> (local device supports <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> on receive) and <b>None</b> (local device does not support flow control). Depending on the result of the negotiation with the link partner, local resolution flow control type will display <b>Symmetric</b> (local device supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (local device supports <b>PAUSE</b> on receive), and <b>None</b> (local device does not support flow control).</li> <li>• <b>Remote fault</b>—Remote fault information. <b>Link OK</b> (no error detected on receive), <b>Offline</b> (local interface is offline), and <b>Link Failure</b> (link error detected on receive).</li> </ul> </li> </ul> | extensive       |
| Received path trace, Transmitted path trace | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other router manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the router at the other end of the fiber. The transmitted path trace value is the message that this router transmits.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | extensive       |
| Packet Forwarding Engine configuration      | <p>Information about the configuration of the Packet Forwarding Engine:</p> <ul style="list-style-type: none"> <li>• <b>Destination slot</b>—FPC slot number.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | extensive       |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>CoS information</b>   | <p>Information about the CoS queue for the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>CoS transmit queue</b>—Queue number and its associated user-configured forwarding class name.</li> <li>• <b>Bandwidth %</b>—Percentage of bandwidth allocated to the queue.</li> <li>• <b>Bandwidth bps</b>—Bandwidth allocated to the queue (in bps).</li> <li>• <b>Buffer %</b>—Percentage of buffer space allocated to the queue.</li> <li>• <b>Buffer usec</b>—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time.</li> <li>• <b>Priority</b>—Queue priority: <b>low</b> or <b>high</b>.</li> <li>• <b>Limit</b>—Displayed if rate limiting is configured for the queue. Possible values are <b>none</b> and <b>exact</b>. If <b>exact</b> is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If <b>none</b> is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.</li> </ul> | <b>extensive</b>             |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
| <b>Logical interface</b> | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | All levels                   |
| <b>Index</b>             | Index number of the logical interface, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>      | SNMP interface index number for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b>      |
| <b>Flags</b>             | Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All levels                   |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                                                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Level of Output                    |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>VLAN-Tag</b>                                           | <p>Rewrite profile applied to incoming or outgoing frames on the outer (<b>Out</b>) VLAN tag or for both the outer and inner (<b>In</b>) VLAN tags.</p> <ul style="list-style-type: none"> <li><b>push</b>—An outer VLAN tag is pushed in front of the existing VLAN tag.</li> <li><b>pop</b>—The outer VLAN tag of the incoming frame is removed.</li> <li><b>swap</b>—The outer VLAN tag of the incoming frame is overwritten with the user-specified VLAN tag information.</li> <li><b>push</b>—An outer VLAN tag is pushed in front of the existing VLAN tag.</li> <li><b>push-push</b>—Two VLAN tags are pushed in from the incoming frame.</li> <li><b>swap-push</b>—The outer VLAN tag of the incoming frame is replaced by a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.</li> <li><b>swap-swap</b>—Both the inner and the outer VLAN tags of the incoming frame are replaced by the user-specified VLAN tag value.</li> <li><b>pop-swap</b>—The outer VLAN tag of the incoming frame is removed, and the inner VLAN tag of the incoming frame is replaced by the user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.</li> <li><b>pop-pop</b>—Both the outer and inner VLAN tags of the incoming frame are removed.</li> </ul> | <b>brief detail extensive none</b> |
| <b>Demux</b>                                              | <p>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</p> <ul style="list-style-type: none"> <li>Source Family Inet</li> <li>Destination Family Inet</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b>       |
| <b>Encapsulation</b>                                      | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All levels                         |
| <b>ACI VLAN: Dynamic Profile</b>                          | Name of the dynamic profile that defines the agent circuit identifier (ACI) interface set. If configured, the ACI interface set enables the underlying Ethernet interface to create dynamic VLAN subscriber interfaces based on ACI information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>brief detail extensive none</b> |
| <b>Protocol</b>                                           | Protocol family. Possible values are described in the "Protocol Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b>       |
| <b>MTU</b>                                                | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive none</b>       |
| <b>Neighbor Discovery Protocol (NDP) Queue Statistics</b> | <p>NDP statistics for protocol <b>inet6</b> under logical interface statistics.</p> <ul style="list-style-type: none"> <li><b>Max nh cache</b>—Maximum interface neighbor discovery nexthop cache size.</li> <li><b>New hold nh limit</b>—Maximum number of new unresolved nexthops.</li> <li><b>Curr nh cnt</b>—Current number of resolved nexthops in the NDP queue.</li> <li><b>Curr new hold cnt</b>—Current number of unresolved nexthops in the NDP queue.</li> <li><b>NH drop cnt</b>—Number of NDP requests not serviced.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All levels                         |
| <b>Dynamic Profile</b>                                    | Name of the dynamic profile that was used to create this interface configured with a Point-to-Point Protocol over Ethernet (PPPoE) family.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b>       |
| <b>Service Name Table</b>                                 | Name of the service name table for the interface configured with a PPPoE family.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive none</b>       |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Level of Output              |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Max Sessions</b>            | Maximum number of PPPoE logical interfaces that can be activated on the underlying interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b> |
| <b>Duplicate Protection</b>    | State of PPPoE duplicate protection: <b>On</b> or <b>Off</b> . When duplicate protection is configured for the underlying interface, a dynamic PPPoE logical interface cannot be activated when an existing active logical interface is present for the same PPPoE client.                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Direct Connect</b>          | State of the configuration to ignore DSL Forum VSAs: <b>On</b> or <b>Off</b> . When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive none</b> |
| <b>AC Name</b>                 | Name of the access concentrator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive none</b> |
| <b>Maximum labels</b>          | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Traffic statistics</b>      | <p>Number and rate of bytes and packets received and transmitted on the specified interface set.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the interface set. The value in this field also includes the Layer 2 overhead bytes for ingress or egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the interface set.</li> </ul>                                                                           | <b>detail extensive</b>      |
| <b>IPv6 transit statistics</b> | Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>extensive</b>             |
| <b>Local statistics</b>        | Number and rate of bytes and packets destined to the router.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>extensive</b>             |
| <b>Transit statistics</b>      | <p>Number and rate of bytes and packets transiting the switch.</p> <p><b>NOTE:</b> For Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces, the logical interface egress statistics might not accurately reflect the traffic on the wire when output shaping is applied. Traffic management output shaping might drop packets after they are tallied by the <b>Output bytes</b> and <b>Output packets</b> interface counters. However, correct values display for both of these egress statistics when per-unit scheduling is enabled for the Gigabit Ethernet IQ2 physical interface, or when a single logical interface is actively using a shared scheduler.</p> | <b>extensive</b>             |
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b>      |
| <b>Route Table</b>             | Route table in which the logical interface address is located. For example, <b>0</b> refers to the routing table inet.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive none</b> |
| <b>Flags</b>                   | Information about protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive</b>      |

Table 99: show interfaces (Gigabit Ethernet) Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                    | Level of Output              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Donor interface</b>          | (Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.                                                                                                 | <b>detail extensive none</b> |
| <b>Preferred source address</b> | (Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.                                        | <b>detail extensive none</b> |
| <b>Input Filters</b>            | Names of any input filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parentheses next to all interfaces.  | <b>detail extensive</b>      |
| <b>Output Filters</b>           | Names of any output filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parentheses next to all interfaces. | <b>detail extensive</b>      |
| <b>Mac-Validate Failures</b>    | Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.                                           | <b>detail extensive none</b> |
| <b>Addresses, Flags</b>         | Information about the address flags. Possible values are described in the "Addresses Flags" section under <i>Common Output Fields Description</i> .                                                  | <b>detail extensive none</b> |
| <b><i>protocol-family</i></b>   | Protocol family configured on the logical interface. If the protocol is <b>inet</b> , the IP address of the interface is also displayed.                                                             | <b>brief</b>                 |
| <b>Flags</b>                    | Information about the address flag. Possible values are described in the "Addresses Flags" section under <i>Common Output Fields Description</i> .                                                   | <b>detail extensive none</b> |
| <b>Destination</b>              | IP address of the remote side of the connection.                                                                                                                                                     | <b>detail extensive none</b> |
| <b>Local</b>                    | IP address of the logical interface.                                                                                                                                                                 | <b>detail extensive none</b> |
| <b>Broadcast</b>                | Broadcast address of the logical interface.                                                                                                                                                          | <b>detail extensive none</b> |
| <b>Generation</b>               | Unique number for use by Juniper Networks technical support only.                                                                                                                                    | <b>detail extensive</b>      |

Table 100: Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type

| Interface Type             | Sample Command                                      | Byte and Octet Counts Include                                                                                                                                                                                | Comments                                |
|----------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Inbound physical interface | <b>show interfaces</b><br><b>ge-0/3/0 extensive</b> | Traffic statistics:<br><br>Input bytes: 496 bytes per packet, representing the Layer 2 packet<br><br>MAC statistics:<br><br>Received octets: 500 bytes per packet, representing the Layer 2 packet + 4 bytes | The additional 4 bytes are for the CRC. |

Table 100: Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type (*continued*)

| Interface Type              | Sample Command                               | Byte and Octet Counts Include                                                                                                                                                                                 | Comments                                                                                                                                           |
|-----------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound logical interface   | <b>show interfaces ge-0/3/0.50 extensive</b> | Traffic statistics:<br><br>Input bytes: 478 bytes per packet, representing the Layer 3 packet                                                                                                                 |                                                                                                                                                    |
| Outbound physical interface | <b>show interfaces ge-0/0/0 extensive</b>    | Traffic statistics:<br><br>Input bytes: 490 bytes per packet, representing the Layer 3 packet + 12 bytes<br><br>MAC statistics:<br><br>Received octets: 478 bytes per packet, representing the Layer 3 packet | For input bytes, the additional 12 bytes include 6 bytes for the destination MAC address plus 4 bytes for VLAN plus 2 bytes for the Ethernet type. |
| Outbound logical interface  | <b>show interfaces ge-0/0/0.50 extensive</b> | Traffic statistics:<br><br>Input bytes: 478 bytes per packet, representing the Layer 3 packet                                                                                                                 |                                                                                                                                                    |

## Sample Output

### show interfaces (Gigabit Ethernet)

```

user@host> show interfaces ge-3/0/2
Physical interface: ge-3/0/2, Enabled, Physical link is Up
  Interface index: 167, SNMP ifIndex: 35
  Link-level type: 52, MTU: 1522, Speed: 1000mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled
  Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  CoS queues    : 4 supported, 4 maximum usable queues
  Current address: 00:05:85:4a:e9:7c, Hardware address: 00:05:85:4a:e9:7c
  Last flapped  : 2006-08-10 17:25:10 PDT (00:01:08 ago)
  Input rate    : 0 bps (0 pps)
  Output rate   : 0 bps (0 pps)
  Ingress rate at Packet Forwarding Engine      : 0 bps (0 pps)
  Ingress drop rate at Packet Forwarding Engine : 0 bps (0 pps)
  Active alarms : None
  Active defects: None

Logical interface ge-3/0/2.0 (Index 72) (SNMP ifIndex 69)
  Flags: SNMP-Traps 0x4000
  VLAN-Tag [ 0x8100.512 0x8100.513 ] In(pop-swap 0x8100.530) Out(swap-push
0x8100.512 0x8100.513)
  Encapsulation: VLAN-CCC
  Egress account overhead: 100
  Ingress account overhead: 90
  Input packets : 0
  Output packets: 0
  Protocol ccc, MTU: 1522
  Flags: Is-Primary

```

**show interfaces (Gigabit Ethernet on MX Series Routers)**

```

user@host> show interfaces ge-2/2/2
Physical interface: ge-2/2/2, Enabled, Physical link is Up
  Interface index: 156, SNMP ifIndex: 188
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, MAC-REWRITE Error: None,
  Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 4 maximum usable queues
  Schedulers     : 0
  Current address: 00:1f:12:b7:d7:c0, Hardware address: 00:1f:12:b7:d6:76
  Last flapped   : 2008-09-05 16:44:30 PDT (3d 01:04 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None
  Logical interface ge-2/2/2.0 (Index 82) (SNMP ifIndex 219)
    Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
    Input packets : 10232
    Output packets: 10294
    Protocol inet, MTU: 1500
      Flags: Sendbroadcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255
    Protocol inet6, MTU: 1500
      Max nh cache: 4, New hold nh limit: 100000, Curr nh cnt: 4, Curr new hold
      cnt: 4, NH drop cnt: 0
      Flags: Is-Primary
      Addresses, Flags: Is-Default Is-Preferred Is-Primary
        Destination: 2001:db8::/32, Local: 2001:db8::5
      Addresses, Flags: Is-Preferred
        Destination: 2001:db8::/32, Local: 2001:db8:223:9cff:fe9f:3e78
    Protocol multiservice, MTU: Unlimited
      Flags: Is-Primary

```

**show interfaces extensive (Gigabit Ethernet on MX Series Routers showing interface transmit statistics configuration)**

```

user@host> show interfaces ge-2/1/2 extensive | match "output|interface"
Physical interface: ge-2/1/2, Enabled, Physical link is Up
  Interface index: 151, SNMP ifIndex: 530, Generation: 154
  Interface flags: SNMP-Traps Internal: 0x4000
  Output bytes   :          240614363944          772721536 bps
  Output packets :          3538446506          1420444 pps
  Direction     : Output
  Interface transmit statistics: Enabled

  Logical interface ge-2/1/2.0 (Index 331) (SNMP ifIndex 955) (Generation 146)
    Output bytes   :          195560312716          522726272 bps
    Output packets :          4251311146          1420451 pps

```

**show interfaces brief (Gigabit Ethernet)**

```

user@host> show interfaces ge-3/0/2 brief
Physical interface: ge-3/0/2, Enabled, Physical link is Up
  Link-level type: 52, MTU: 1522, Speed: 1000mbps, Loopback: Disabled,

```



Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,  
 Remote fault: Online  
 Device flags : Present Running  
 Interface flags: SNMP-Traps Internal: 0x4000  
 Link flags : None

Logical interface ge-3/0/2.0  
 Flags: SNMP-Traps 0x4000  
 VLAN-Tag [ 0x8100.512 0x8100.513 ] In(pop-swap 0x8100.530) Out(swap-push  
 0x8100.512 0x8100.513)  
 Encapsulation: VLAN-CCC  
 ccc

Logical interface ge-3/0/2.32767  
 Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x0000.0 ] Encapsulation: ENET2

### show interfaces detail (Gigabit Ethernet)

```
user@host> show interfaces ge-3/0/2 detail
Physical interface: ge-3/0/2, Enabled, Physical link is Up
  Interface index: 167, SNMP ifIndex: 35, Generation: 177
  Link-level type: 52, MTU: 1522, Speed: 1000mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags : None
  CoS queues : 4 supported, 4 maximum usable queues
  Hold-times : Up 0 ms, Down 0 ms
  Current address: 00:05:85:4a:e9:7c, Hardware address: 00:05:85:4a:e9:7c
  Last flapped : 2006-08-09 17:17:00 PDT (01:31:33 ago)
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes : 0 0 bps
    Output bytes : 0 0 bps
    Input packets: 0 0 pps
    Output packets: 0 0 pps
  Ingress traffic statistics at Packet Forwarding Engine:
    Input bytes : 0 0 bps
    Input packets: 0 0 pps
    Drop bytes : 0 0 bps
    Drop packets: 0 0 pps
  Ingress queues: 4 supported, 4 in use
  Queue counters:
    Queued packets Transmitted packets Dropped packets

    0 best-effort 0 0 0
    1 expedited-fo 0 0 0
    2 assured-forw 0 0 0
    3 network-cont 0 0 0

  Egress queues: 4 supported, 4 in use
  Queue counters:
    Queued packets Transmitted packets Dropped packets

    0 best-effort 0 0 0
    1 expedited-fo 0 0 0
    2 assured-forw 0 0 0
```

```

3 network-cont                                0                                0                                0

Active alarms : None
Active defects : None

Logical interface ge-3/0/2.0 (Index 72) (SNMP ifIndex 69) (Generation 140)
  Flags: SNMP-Traps 0x4000
  VLAN-Tag [0x8100.512 0x8100.513 ] In(pop-swap 0x8100.530)
  Out(swap-push 0x8100.512 0x8100.513)
  Encapsulation: VLAN-CCC
  Egress account overhead: 100
  Ingress account overhead: 90
  Traffic statistics:
    Input bytes : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
  Local statistics:
    Input bytes : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
  Transit statistics:
    Input bytes : 0 0 bps
    Output bytes : 0 0 bps
    Input packets: 0 0 pps
    Output packets: 0 0 pps
  Protocol ccc, MTU: 1522, Generation: 149, Route table: 0
  Flags: Is-Primary

Logical interface ge-3/0/2.32767 (Index 71) (SNMP ifIndex 70)
(Generation 139)
  Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x0000.0 ] Encapsulation: ENET2
  Traffic statistics:
    Input bytes : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
  Local statistics:
    Input bytes : 0
    Output bytes : 0
    Input packets: 0
    Output packets: 0
  Transit statistics:
    Input bytes : 0 0 bps
    Output bytes : 0 0 bps
    Input packets: 0 0 pps
    Output packets: 0 0 pps

```

### show interfaces extensive (Gigabit Ethernet IQ2)

```

user@host> show interfaces ge-7/1/3 extensive
Physical interface: ge-7/1/3, Enabled, Physical link is Up
Interface index: 170, SNMP ifIndex: 70, Generation: 171
Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
Remote fault: Online
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4004000
Link flags : None

```

```

CoS queues      : 8 supported, 4 maximum usable queues
Schedulers     : 256
Hold-times      : Up 0 ms, Down 0 ms
Current address: 00:14:f6:30:5e:74, Hardware address: 00:14:f6:30:5e:74
Last flapped    : 2007-11-07 21:31:41 PST (02:03:33 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes :          38910844056          7952 bps
Output bytes :           7174605          8464 bps
Input packets:         418398473           11 pps
Output packets:         78903           12 pps
IPv6 transit statistics:
Input bytes :              0
Output bytes :              0
Input packets:              0
Output packets:              0
Ingress traffic statistics at Packet Forwarding Engine:
Input bytes :         38910799145          7952 bps
Input packets:         418397956           11 pps
Drop bytes :              0           0 bps
Drop packets:              0           0 pps
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
FIFO errors: 0, Resource errors: 0
Output errors:
Carrier transitions: 1, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Ingress queues: 4 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

0 best-effort          418390823          418390823              0

1 expedited-fo              0              0              0

2 assured-forw              0              0              0

3 network-cont           7133           7133              0

Egress queues: 4 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

0 best-effort          1031           1031              0

1 expedited-fo              0              0              0

2 assured-forw              0              0              0

3 network-cont          77872          77872              0

Active alarms : None
Active defects : None
MAC statistics:
Total octets          Receive          Transmit
Total packets         418398473          78903
Unicast packets       408021893366        1026
Broadcast packets           10           12
Multicast packets     418398217          77865
CRC/Align errors              0              0
FIFO errors              0              0

```

```

MAC control frames          0          0
MAC pause frames            0          0
Oversized frames            0
Jabber frames                0
Fragment frames             0
VLAN tagged frames          0
Code violations              0 OTN Received Overhead Bytes:
APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58
Payload Type: 0x08
OTN Transmitted Overhead Bytes:
APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
Payload Type: 0x08
Filter statistics:
Input packet count          418398473
Input packet rejects        479
Input DA rejects            479
Input SA rejects            0
Output packet count          78903
Output packet pad count      0
Output packet error count    0
CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
Negotiation status: Complete
Link partner:
Link mode: Full-duplex, Flow control: Symmetric/Asymmetric,
Remote fault: OK
Local resolution:
Flow control: Symmetric, Remote fault: Link OK
Packet Forwarding Engine configuration:
Destination slot: 7
CoS information:
Direction : Output
CoS transmit queue          Bandwidth          Buffer          Priority          Limit
                             %          bps          %          usec
0 best-effort                95          950000000      95          0
low none
3 network-control            5          500000000      5          0
low none
Direction : Input
CoS transmit queue          Bandwidth          Buffer          Priority          Limit
                             %          bps          %          usec
0 best-effort                95          950000000      95          0
low none
3 network-control            5          500000000      5          0
low none

Logical interface ge-7/1/3.0 (Index 70) (SNMP ifIndex 85) (Generation 150)
Flags: SNMP-Traps Encapsulation: ENET2
Traffic statistics:
Input bytes :                812400
Output bytes :               1349206
Input packets:                9429
Output packets:               9449
IPv6 transit statistics:
Input bytes :                 0
Output bytes :                 0
Input packets:                 0
Output packets:                 0
Local statistics:
Input bytes :                812400
Output bytes :               1349206

```

```

Input packets:          9429
Output packets:         9449
Transit statistics:
Input bytes :           0          7440 bps
Output bytes :          0          7888 bps
Input packets:          0          10 pps
Output packets:         0          11 pps
IPv6 transit statistics:
Input bytes :           0
Output bytes :          0
Input packets:          0
Output packets:         0
Protocol inet, MTU: 1500, Generation: 169, Route table: 0
Flags: Is-Primary, Mac-Validate-Strict
Mac-Validate Failures: Packets: 0, Bytes: 0
Addresses, Flags: Is-Preferred Is-Primary
Input Filters: F1-ge-3/0/1.0-in, F3-ge-3/0/1.0-in
Output Filters: F2-ge-3/0/1.0-out (53)
Destination: 10.74.2/24, Local: 10.74.2.2, Broadcast: 10.74.2.255,
Generation: 196
Protocol multiservice, MTU: Unlimited, Generation: 170, Route table: 0
Flags: Is-Primary
Policer: Input: __default_arp_policer__

```

**NOTE:** For Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces, the logical interface egress statistics displayed in the **show interfaces** command output might not accurately reflect the traffic on the wire when output shaping is applied. Traffic management output shaping might drop packets after they are tallied by the interface counters. For detailed information, see the description of the logical interface **Transit statistics** fields in [Table 99 on page 1580](#).

### show interfaces (Gigabit Ethernet Unnumbered Interface)

```

user@host> show interfaces ge-3/2/0
Physical interface: ge-3/2/0, Enabled, Physical link is Up
Interface index: 148, SNMP ifIndex: 50
Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
Remote fault: Online
Device flags   : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Link flags     : None
CoS queues     : 8 supported, 4 maximum usable queues
Current address: 00:14:f6:11:26:f8, Hardware address: 00:14:f6:11:26:f8
Last flapped   : 2006-10-27 04:42:23 PDT (08:01:52 ago)
Input rate      : 0 bps (0 pps)
Output rate     : 624 bps (1 pps)
Active alarms   : None
Active defects  : None

Logical interface ge-3/2/0.0 (Index 67) (SNMP ifIndex 85)
Flags: SNMP-Traps Encapsulation: ENET2
Input packets : 0
Output packets: 6
Protocol inet, MTU: 1500
Flags: Unnumbered
Donor interface: lo0.0 (Index 64)
Preferred source address: 192.02.5

```

**show interfaces (ACI Interface Set Configured)**

```
user@host> show interfaces ge-1/0/0.4001
Logical interface ge-1/0/0.4001 (Index 340) (SNMP ifIndex 548)
  Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.4001 ] Encapsulation: PPP-over-
    Ethernet
    ACI VLAN:
      Dynamic Profile: aci-vlan-set-profile
    PPPoE:
      Dynamic Profile: aci-vlan-pppoe-profile,
      Service Name Table: None,
      Max Sessions: 32000, Max Sessions VSA Ignore: Off,
      Duplicate Protection: On, Short Cycle Protection: Off,
      Direct Connect: Off,
      AC Name: nbc
    Input packets : 9
    Output packets: 8
    Protocol multiservice, MTU: Unlimited
```

## show interfaces (10-Gigabit Ethernet)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces <i>xe-fpc/pic/port</i> &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | Display status information about the specified 10-Gigabit Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p><i>xe-fpc/pic/port</i>—Display standard information about the specified 10-Gigabit Ethernet interface.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p>                                                                                                                  |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, IQ2) on page 1618</a></p> <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, WAN PHY Mode) on page 1621</a></p> <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, DWDM OTN PIC) on page 1623</a></p> <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode) on page 1625</a></p> <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Transmit-Only) on page 1625</a></p> <p><a href="#">show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Receive-Only) on page 1626</a></p> |
| <b>Output Fields</b>            | See <a href="#">Table 101 on page 1604</a> for the output fields for the <b>show interfaces</b> (10-Gigabit Ethernet) command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

Table 101: show interfaces Gigabit Ethernet Output Fields

| Field Name                | Field Description                                                                                                                                                                                                                               | Level of Output              |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Physical Interface</b> |                                                                                                                                                                                                                                                 |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                                                                                                                                 | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .                                                                                                            | All levels                   |
| <b>Interface index</b>    | Index number of the physical interface, which reflects its initialization sequence.                                                                                                                                                             | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                                                                                                                                   | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                               | <b>detail extensive</b>      |
| <b>Link-level type</b>    | Encapsulation being used on the physical interface.                                                                                                                                                                                             | All levels                   |
| <b>MTU</b>                | Maximum transmission unit size on the physical interface.                                                                                                                                                                                       | All levels                   |
| <b>Speed</b>              | Speed at which the interface is running.                                                                                                                                                                                                        | All levels                   |
| <b>Loopback</b>           | Loopback status: <b>Enabled</b> or <b>Disabled</b> . If loopback is enabled, type of loopback: <b>Local</b> or <b>Remote</b> .                                                                                                                  | All levels                   |
| <b>Source filtering</b>   | Source filtering status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                    | All levels                   |
| <b>LAN-PHY mode</b>       | 10-Gigabit Ethernet interface operating in Local Area Network Physical Layer Device (LAN PHY) mode. LAN PHY allows 10-Gigabit Ethernet wide area links to use existing Ethernet applications.                                                   | All levels                   |
| <b>WAN-PHY mode</b>       | 10-Gigabit Ethernet interface operating in Wide Area Network Physical Layer Device (WAN PHY) mode. WAN PHY allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and other devices intended for SONET/SDH.                       | All levels                   |
| <b>Unidirectional</b>     | Unidirectional link mode status for 10-Gigabit Ethernet interface: <b>Enabled</b> or <b>Disabled</b> for parent interface; <b>Rx-only</b> or <b>Tx-only</b> for child interfaces.                                                               | All levels                   |
| <b>Flow control</b>       | Flow control status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                        | All levels                   |
| <b>Auto-negotiation</b>   | (Gigabit Ethernet interfaces) Autonegotiation status: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                       | All levels                   |
| <b>Remote-fault</b>       | (Gigabit Ethernet interfaces) Remote fault status: <ul style="list-style-type: none"> <li><b>Online</b>—Autonegotiation is manually configured as online.</li> <li><b>Offline</b>—Autonegotiation is manually configured as offline.</li> </ul> | All levels                   |
| <b>Device flags</b>       | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                              | All levels                   |
| <b>Interface flags</b>    | Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                 | All levels                   |



Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                                                                                           | Level of Output              |                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------------------|
| <b>Link flags</b>               | Information about the link. Possible values are described in the “Links Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                      | All levels                   |                         |
| <b>Wavelength</b>               | (10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).                                                                                                                                      | All levels                   |                         |
| <b>Frequency</b>                | (10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).                                                                                                                                            | All levels                   |                         |
| <b>CoS queues</b>               | Number of CoS queues configured.                                                                                                                                                                                                                                            | <b>detail extensive</b> none |                         |
| <b>Schedulers</b>               | (Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces only) Number of CoS schedulers configured.                                                                                                                                                                         | <b>extensive</b>             |                         |
| <b>Hold-times</b>               | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                                         | <b>detail extensive</b>      |                         |
| <b>Current address</b>          | Configured MAC address.                                                                                                                                                                                                                                                     | <b>detail extensive</b> none |                         |
| <b>Hardware address</b>         | Hardware MAC address.                                                                                                                                                                                                                                                       | <b>detail extensive</b> none |                         |
| <b>Last flapped</b>             | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> .                        | <b>detail extensive</b> none |                         |
| <b>Input Rate</b>               | Input rate in bits per second (bps) and packets per second (pps). The value in this field also includes the Layer 2 overhead bytes for ingress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level. | None specified               |                         |
| <b>Output Rate</b>              | Output rate in bps and pps. The value in this field also includes the Layer 2 overhead bytes for egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.                                        | None specified               |                         |
| <b>Statistics last cleared</b>  | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                           | <b>detail extensive</b>      |                         |
| <b>Egress account overhead</b>  | Layer 2 overhead in bytes that is accounted in the interface statistics for egress traffic.                                                                                                                                                                                 | <b>detail extensive</b>      |                         |
| <b>Ingress account overhead</b> | Layer 2 overhead in bytes that is accounted in the interface statistics for ingress traffic.                                                                                                                                                                                | <b>detail extensive</b>      | <b>detail extensive</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output         |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Traffic statistics</b> | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface. The value in this field also includes the Layer 2 overhead bytes for ingress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface. The value in this field also includes the Layer 2 overhead bytes for egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> <p>Gigabit Ethernet and 10-Gigabit Ethernet IQ PICs count the overhead and CRC bytes.</p> <p>For Gigabit Ethernet IQ PICs, the input byte counts vary by interface type. For more information, see <a href="#">Table 101 on page 1604</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b> |
| <b>Input errors</b>       | <p>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>L3 incompletes</b>—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. L3 incomplete errors can be ignored by configuring the <code>ignore-l3-incompletes</code> statement.</li> <li>• <b>L2 channel errors</b>—Number of times the software did not find a valid logical interface for an incoming frame.</li> <li>• <b>L2 mismatch timeouts</b>—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>        |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output         |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Output errors</b>           | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Collisions</b>—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug.</li> <li>• <b>Aged packets</b>—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware.</li> <li>• <b>FIFO errors</b>—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</li> <li>• <b>HS link CRC errors</b>—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>        |
| <b>Egress queues</b>           | <p>Total number of egress queues supported on the specified interface.</p> <p><b>NOTE:</b> In DPCs that are not of the enhanced type, such as DPC 40x1GE R, DPCE 20x1GE + 2x10GE R, or DPCE 40x1GE R, you might notice a discrepancy in the output of the <b>show interfaces</b> command because incoming packets might be counted in the Egress queues section of the output. This problem occurs on non-enhanced DPCs because the egress queue statistics are polled from IMQ (Inbound Message Queuing) block of the I-chip. The IMQ block does not differentiate between ingress and egress WAN traffic; as a result, the combined statistics are displayed in the egress queue counters on the Routing Engine. In a simple VPLS scenario, if there is no MAC entry in DMAC table (by sending unidirectional traffic), traffic is flooded and the input traffic is accounted in IMQ. For bidirectional traffic (MAC entry in DMAC table), if the outgoing interface is on the same I-chip then both ingress and egress statistics are counted in a combined way. If the outgoing interface is on a different I-chip or FPC, then only egress statistics are accounted in IMQ. This behavior is expected with non-enhanced DPCs</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b> |
| <b>Queue counters (Egress)</b> | <p>CoS queue number and its associated user-configured forwarding class name.</p> <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                              | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Level of Output              |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Ingress queues</b>                   | Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>extensive</b>             |
| <b>Queue counters (Ingress)</b>         | CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces. <ul style="list-style-type: none"> <li>• <b>Queued packets</b>—Number of queued packets.</li> <li>• <b>Transmitted packets</b>—Number of transmitted packets.</li> <li>• <b>Dropped packets</b>—Number of packets dropped by the ASIC's RED mechanism.</li> </ul>                                                                                                                                                                                                                                                                                                                               | <b>extensive</b>             |
| <b>Active alarms and Active defects</b> | Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the routing device configuration, an alarm can ring the red or yellow alarm bell on the routing device, or turn on the red or yellow alarm LED on the craft interface. These fields can contain the value <b>None</b> or <b>Link</b> . <ul style="list-style-type: none"> <li>• <b>None</b>—There are no active defects or alarms.</li> <li>• <b>Link</b>—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.</li> </ul> | <b>detail extensive none</b> |
| <b>OTN alarms</b>                       | Active OTN alarms identified on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b>      |
| <b>OTN defects</b>                      | OTN defects received on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b>      |
| <b>OTN FEC Mode</b>                     | The FECmode configured on the interface. <ul style="list-style-type: none"> <li>• <b>efec</b>—Enhanced forward error correction (EFEC) is configured to detect and correct bit errors.</li> <li>• <b>gfec</b>—G.709 Forward error correction (GFEC) mode is configured to detect and correct bit errors.</li> <li>• <b>none</b>—FEC mode is not configured.</li> </ul>                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b>      |
| <b>OTN Rate</b>                         | OTN mode. <ul style="list-style-type: none"> <li>• <b>fixed-stuff-bytes</b>—Fixed stuff bytes 11.0957 Gbps.</li> <li>• <b>no-fixed-stuff-bytes</b>—No fixed stuff bytes 11.0491 Gbps.</li> <li>• <b>pass-through</b>—Enable OTN passthrough mode.</li> <li>• <b>no-pass-through</b>—Do not enable OTN passthrough mode.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive</b>      |
| <b>OTN Line Loopback</b>                | Status of the line loopback, if configured for the DWDM OTN PIC. Its value can be: <b>enabled</b> or <b>disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b>      |
| <b>OTN FEC statistics</b>               | The forward error correction (FEC) counters for the DWDM OTN PIC. <ul style="list-style-type: none"> <li>• <b>Corrected Errors</b>—The count of corrected errors in the last second.</li> <li>• <b>Corrected Error Ratio</b>—The corrected error ratio in the last 25 seconds. For example, 1e-7 is 1 error per 10 million bits.</li> </ul>                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b>      |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level of Output         |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>OTN FEC alarms</b>   | OTN FEC excessive or degraded error alarms triggered on the interface. <ul style="list-style-type: none"> <li><b>FEC Degrade</b>—OTU FEC Degrade defect.</li> <li><b>FEC Excessive</b>—OTU FEC Excessive Error defect.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b> |
| <b>OTN OC</b>           | OTN OC defects triggered on the interface. <ul style="list-style-type: none"> <li><b>LOS</b>—OC Loss of Signal defect.</li> <li><b>LOF</b>—OC Loss of Frame defect.</li> <li><b>LOM</b>—OC Loss of Multiframe defect.</li> <li><b>Wavelength Lock</b>—OC Wavelength Lock defect.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive</b> |
| <b>OTN OTU</b>          | OTN OTU defects detected on the interface <ul style="list-style-type: none"> <li><b>AIS</b>—OTN AIS alarm.</li> <li><b>BDI</b>—OTN OTU BDI alarm.</li> <li><b>IAE</b>—OTN OTU IAE alarm.</li> <li><b>TTIM</b>—OTN OTU TTIM alarm.</li> <li><b>SF</b>—OTN ODU bit error rate fault alarm.</li> <li><b>SD</b>—OTN ODU bit error rate defect alarm.</li> <li><b>TCA-ES</b>—OTN ODU ES threshold alarm.</li> <li><b>TCA-SES</b>—OTN ODU SES threshold alarm.</li> <li><b>TCA-UAS</b>—OTN ODU UAS threshold alarm.</li> <li><b>TCA-BBE</b>—OTN ODU BBE threshold alarm.</li> <li><b>BIP</b>—OTN ODU BIP threshold alarm.</li> <li><b>BBE</b>—OTN OTU BBE threshold alarm.</li> <li><b>ES</b>—OTN OTU ES threshold alarm.</li> <li><b>SES</b>—OTN OTU SES threshold alarm.</li> <li><b>UAS</b>—OTN OTU UAS threshold alarm.</li> </ul> | <b>detail extensive</b> |
| <b>Received DAPI</b>    | Destination Access Port Interface (DAPI) from which the packets were received.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>detail extensive</b> |
| <b>Received SAPI</b>    | Source Access Port Interface (SAPI) from which the packets were received.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>Transmitted DAPI</b> | Destination Access Port Interface (DAPI) to which the packets were transmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive</b> |
| <b>Transmitted SAPI</b> | Source Access Port Interface (SAPI) to which the packets were transmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b> |
| <b>PCS statistics</b>   | (10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device. <ul style="list-style-type: none"> <li><b>Bit errors</b>—The number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.</li> <li><b>Errored blocks</b>—The number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.</li> </ul>                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                            | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Level of Output  |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>MAC statistics</b>                 | <p>Receive and Transmit statistics reported by the PIC's MAC subsystem, including the following:</p> <ul style="list-style-type: none"> <li>• <b>Total octets</b> and <b>total packets</b>—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. For more information, see <a href="#">Table 102 on page 1618</a></li> <li>• <b>Unicast packets</b>, <b>Broadcast packets</b>, and <b>Multicast packets</b>—Number of unicast, broadcast, and multicast packets.</li> <li>• <b>CRC/Align errors</b>—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error).</li> <li>• <b>FIFO error</b>—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC or a cable is probably malfunctioning.</li> <li>• <b>MAC control frames</b>—Number of MAC control frames.</li> <li>• <b>MAC pause frames</b>—Number of MAC control frames with <b>pause</b> operational code.</li> <li>• <b>Oversized frames</b>—Number of frames that exceed 1518 octets.</li> <li>• <b>Jabber frames</b>—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms.</li> <li>• <b>Fragment frames</b>—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. Fragment frames normally increment because both runts (which are normal occurrences caused by collisions) and noise hits are counted.</li> <li>• <b>VLAN tagged frames</b>—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not.</li> <li>• <b>Code violations</b>—Number of times an event caused the PHY to indicate "Data reception error" or "invalid data symbol error."</li> </ul> | <b>extensive</b> |
| <b>OTN Received Overhead Bytes</b>    | APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>extensive</b> |
| <b>OTN Transmitted Overhead Bytes</b> | APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00 Payload Type: 0x08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>extensive</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name        | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level of Output |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Filter statistics | <p>Receive and Transmit statistics reported by the PIC's MAC address filter subsystem. The filtering is done by the content-addressable memory (CAM) on the PIC. The filter examines a packet's source and destination MAC addresses to determine whether the packet should enter the system or be rejected.</p> <ul style="list-style-type: none"> <li>• <b>Input packet count</b>—Number of packets received from the MAC hardware that the filter processed.</li> <li>• <b>Input packet rejects</b>—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</li> <li>• <b>Input DA rejects</b>—Number of packets that the filter rejected because the destination MAC address of the packet is not on the accept list. It is normal for this value to increment. When it increments very quickly and no traffic is entering the routing device from the far-end system, either there is a bad ARP entry on the far-end system, or multicast routing is not on and the far-end system is sending many multicast packets to the local routing device (which the routing device is rejecting).</li> <li>• <b>Input SA rejects</b>—Number of packets that the filter rejected because the source MAC address of the packet is not on the accept list. The value in this field should increment only if source MAC address filtering has been enabled. If filtering is enabled, if the value increments quickly, and if the system is not receiving traffic that it should from the far-end system, it means that the user-configured source MAC addresses for this interface are incorrect.</li> <li>• <b>Output packet count</b>—Number of packets that the filter has given to the MAC hardware.</li> <li>• <b>Output packet pad count</b>—Number of packets the filter padded to the minimum Ethernet size (60 bytes) before giving the packet to the MAC hardware. Usually, padding is done only on small ARP packets, but some very small IP packets can also require padding. If this value increments rapidly, either the system is trying to find an ARP entry for a far-end system that does not exist or it is misconfigured.</li> <li>• <b>Output packet error count</b>—Number of packets with an indicated error that the filter was given to transmit. These packets are usually aged packets or are the result of a bandwidth problem on the FPC hardware. On a normal system, the value of this field should not increment.</li> <li>• <b>CAM destination filters, CAM source filters</b>—Number of entries in the CAM dedicated to destination and source MAC address filters. There can only be up to 64 source entries. If source filtering is disabled, which is the default, the values for these fields should be 0.</li> </ul> | extensive       |
| PMA PHY           | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>PHY Lock</b>—Phase-locked loop</li> <li>• <b>PHY Light</b>—Loss of optical signal</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | extensive       |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name         | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Level of Output  |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS section</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B1</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>SEF</b>—Severely errored framing</li> <li>• <b>LOL</b>—Loss of light</li> <li>• <b>LOF</b>—Loss of frame</li> <li>• <b>ES-S</b>—Errored seconds (section)</li> <li>• <b>SES-S</b>—Severely errored seconds (section)</li> <li>• <b>SEFS-S</b>—Severely errored framing seconds (section)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>extensive</b> |
| <b>WIS line</b>    | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. State other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B2</b>—Bit interleaved parity for SONET line overhead</li> <li>• <b>REI-L</b>—Remote error indication (near-end line)</li> <li>• <b>RDI-L</b>—Remote defect indication (near-end line)</li> <li>• <b>AIS-L</b>—Alarm indication signal (near-end line)</li> <li>• <b>BERR-SF</b>—Bit error rate fault (signal failure)</li> <li>• <b>BERR-SD</b>—Bit error rate defect (signal degradation)</li> <li>• <b>ES-L</b>—Errored seconds (near-end line)</li> <li>• <b>SES-L</b>—Severely errored seconds (near-end line)</li> <li>• <b>UAS-L</b>—Unavailable seconds (near-end line)</li> <li>• <b>ES-LFE</b>—Errored seconds (far-end line)</li> <li>• <b>SES-LFE</b>—Severely errored seconds (far-end line)</li> <li>• <b>UAS-LFE</b>—Unavailable seconds (far-end line)</li> </ul> | <b>extensive</b> |



Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Level of Output  |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>WIS path</b> | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</p> <ul style="list-style-type: none"> <li>• <b>Seconds</b>—Number of seconds the defect has been active.</li> <li>• <b>Count</b>—Number of times that the defect has gone from inactive to active.</li> <li>• <b>State</b>—State of the error. Any state other than <b>OK</b> indicates a problem.</li> </ul> <p>Subfields are:</p> <ul style="list-style-type: none"> <li>• <b>BIP-B3</b>—Bit interleaved parity for SONET section overhead</li> <li>• <b>REI-P</b>—Remote error indication</li> <li>• <b>LOP-P</b>—Loss of pointer (path)</li> <li>• <b>AIS-P</b>—Path alarm indication signal</li> <li>• <b>RDI-P</b>—Path remote defect indication</li> <li>• <b>UNEQ-P</b>—Path unequipped</li> <li>• <b>PLM-P</b>—Path payload label mismatch</li> <li>• <b>ES-P</b>—Errored seconds (near-end STS path)</li> <li>• <b>SES-P</b>—Severely errored seconds (near-end STS path)</li> <li>• <b>UAS-P</b>—Unavailable seconds (near-end STS path)</li> <li>• <b>SES-PFE</b>—Severely errored seconds (far-end STS path)</li> <li>• <b>UAS-PFE</b>—Unavailable seconds (far-end STS path)</li> </ul> | <b>extensive</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                                  | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Autonegotiation information                 | <p>Information about link autonegotiation.</p> <ul style="list-style-type: none"> <li>• <b>Negotiation status:</b> <ul style="list-style-type: none"> <li>• <b>Incomplete</b>—Ethernet interface has the speed or link mode configured.</li> <li>• <b>No autonegotiation</b>—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.</li> <li>• <b>Complete</b>—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> </ul> </li> <li>• <b>Link partner status</b>—OK when Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</li> <li>• <b>Link partner:</b> <ul style="list-style-type: none"> <li>• <b>Link mode</b>—Depending on the capability of the attached Ethernet device, either <b>Full-duplex</b> or <b>Half-duplex</b>.</li> <li>• <b>Flow control</b>—Types of flow control supported by the remote Ethernet device. For Fast Ethernet interfaces, the type is <b>None</b>. For Gigabit Ethernet interfaces, types are <b>Symmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (link partner supports <b>PAUSE</b> on transmit), and <b>Symmetric/Asymmetric</b> (link partner supports both <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> receive).</li> <li>• <b>Remote fault</b>—Remote fault information from the link partner—<b>Failure</b> indicates a receive link error. <b>OK</b> indicates that the link partner is receiving. <b>Negotiation error</b> indicates a negotiation error. <b>Offline</b> indicates that the link partner is going offline.</li> </ul> </li> <li>• <b>Local resolution</b>—Information from the link partner: <ul style="list-style-type: none"> <li>• <b>Flow control</b>—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are <b>Symmetric</b> (link partner supports <b>PAUSE</b> on receive and transmit), <b>Asymmetric</b> (link partner supports <b>PAUSE</b> on transmit), and <b>Symmetric/Asymmetric</b> (link partner supports both <b>PAUSE</b> on receive and transmit or only <b>PAUSE</b> receive).</li> <li>• <b>Remote fault</b>—Remote fault information. <b>Link OK</b> (no error detected on receive), <b>Offline</b> (local interface is offline), and <b>Link Failure</b> (link error detected on receive).</li> </ul> </li> </ul> | extensive       |
| Received path trace, Transmitted path trace | <p>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other router manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the routing device at the other end of the fiber. The transmitted path trace value is the message that this routing device transmits.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | extensive       |
| Packet Forwarding Engine configuration      | <p>Information about the configuration of the Packet Forwarding Engine:</p> <ul style="list-style-type: none"> <li>• <b>Destination slot</b>—FPC slot number.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | extensive       |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>CoS information</b>   | <p>Information about the CoS queue for the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>CoS transmit queue</b>—Queue number and its associated user-configured forwarding class name.</li> <li>• <b>Bandwidth %</b>—Percentage of bandwidth allocated to the queue.</li> <li>• <b>Bandwidth bps</b>—Bandwidth allocated to the queue (in bps).</li> <li>• <b>Buffer %</b>—Percentage of buffer space allocated to the queue.</li> <li>• <b>Buffer usec</b>—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time.</li> <li>• <b>Priority</b>—Queue priority: <b>low</b> or <b>high</b>.</li> <li>• <b>Limit</b>—Displayed if rate limiting is configured for the queue. Possible values are <b>none</b> and <b>exact</b>. If <b>exact</b> is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If <b>none</b> is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.</li> </ul> | <b>extensive</b>             |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
| <b>Logical interface</b> | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | All levels                   |
| <b>Index</b>             | Index number of the logical interface, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b> none |
| <b>SNMP ifIndex</b>      | SNMP interface index number for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive</b> none |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b>      |
| <b>Flags</b>             | Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All levels                   |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Level of Output                    |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>VLAN-Tag</b>                | <p>Rewrite profile applied to incoming or outgoing frames on the outer (<b>Out</b>) VLAN tag or for both the outer and inner (<b>In</b>) VLAN tags.</p> <ul style="list-style-type: none"> <li>• <b>push</b>—An outer VLAN tag is pushed in front of the existing VLAN tag.</li> <li>• <b>pop</b>—The outer VLAN tag of the incoming frame is removed.</li> <li>• <b>swap</b>—The outer VLAN tag of the incoming frame is overwritten with the user specified VLAN tag information.</li> <li>• <b>push</b>—An outer VLAN tag is pushed in front of the existing VLAN tag.</li> <li>• <b>push-push</b>—Two VLAN tags are pushed in from the incoming frame.</li> <li>• <b>swap-push</b>—The outer VLAN tag of the incoming frame is replaced by a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.</li> <li>• <b>swap-swap</b>—Both the inner and the outer VLAN tags of the incoming frame are replaced by the user specified VLAN tag value.</li> <li>• <b>pop-swap</b>—The outer VLAN tag of the incoming frame is removed, and the inner VLAN tag of the incoming frame is replaced by the user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.</li> <li>• <b>pop-pop</b>—Both the outer and inner VLAN tags of the incoming frame are removed.</li> </ul> | <b>brief detail extensive none</b> |
| <b>Demux:</b>                  | <p>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</p> <ul style="list-style-type: none"> <li>• Source Family Inet</li> <li>• Destination Family Inet</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b>       |
| <b>Encapsulation</b>           | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All levels                         |
| <b>Protocol</b>                | Protocol family. Possible values are described in the “Protocol Field” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b>       |
| <b>MTU</b>                     | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive none</b>       |
| <b>Maximum labels</b>          | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive none</b>       |
| <b>Traffic statistics</b>      | <p>Number and rate of bytes and packets received and transmitted on the specified interface set.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the interface set. The value in this field also includes the Layer 2 overhead bytes for ingress or egress traffic on Ethernet interfaces if you enable accounting of Layer 2 overhead at the PIC level or the logical interface level.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the interface set.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive</b>            |
| <b>IPv6 transit statistics</b> | Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>extensive</b>                   |
| <b>Local statistics</b>        | Number and rate of bytes and packets destined to the routing device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>extensive</b>                   |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level of Output              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Transit statistics</b>       | Number and rate of bytes and packets transiting the switch.<br><br><b>NOTE:</b> For Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces, the logical interface egress statistics might not accurately reflect the traffic on the wire when output shaping is applied. Traffic management output shaping might drop packets after they are tallied by the <b>Output bytes</b> and <b>Output packets</b> interface counters. However, correct values display for both of these egress statistics when per-unit scheduling is enabled for the Gigabit Ethernet IQ2 physical interface, or when a single logical interface is actively using a shared scheduler. | <b>extensive</b>             |
| <b>Generation</b>               | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b>      |
| <b>Route Table</b>              | Route table in which the logical interface address is located. For example, <b>0</b> refers to the routing table inet.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive none</b> |
| <b>Flags</b>                    | Information about protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b>      |
| <b>Donor interface</b>          | (Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b> |
| <b>Preferred source address</b> | (Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive none</b> |
| <b>Input Filters</b>            | Names of any input filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parenthesis next to all interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b>      |
| <b>Output Filters</b>           | Names of any output filters applied to this interface. If you specify a precedence value for any filter in a dynamic profile, filter precedence values appear in parenthesis next to all interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b>      |
| <b>Mac-Validate Failures</b>    | Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive none</b> |
| <b>Addresses, Flags</b>         | Information about the address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b><i>protocol-family</i></b>   | Protocol family configured on the logical interface. If the protocol is <b>inet</b> , the IP address of the interface is also displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>brief</b>                 |
| <b>Flags</b>                    | Information about address flag (possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive none</b> |
| <b>Destination</b>              | IP address of the remote side of the connection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive none</b> |
| <b>Local</b>                    | IP address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive none</b> |
| <b>Broadcast</b>                | Broadcast address of the logical interlace.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>detail extensive none</b> |

Table 101: show interfaces Gigabit Ethernet Output Fields (*continued*)

| Field Name | Field Description                                                 | Level of Output  |
|------------|-------------------------------------------------------------------|------------------|
| Generation | Unique number for use by Juniper Networks technical support only. | detail extensive |

For Gigabit Ethernet IQ PICs, traffic and MAC statistics output varies. [Table 102 on page 1618](#) describes the traffic and MAC statistics for two sample interfaces, each of which is sending traffic in packets of 500 bytes (including 478 bytes for the Layer 3 packet, 18 bytes for the Layer 2 VLAN traffic header, and 4 bytes for cyclic redundancy check [CRC] information). In [Table 102 on page 1618](#), the **ge-0/3/0** interface is the inbound physical interface, and the **ge-0/0/0** interface is the outbound physical interface. On both interfaces, traffic is carried on logical unit .50 (VLAN 50).

Table 102: Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type

| Interface Type              | Sample Command                               | Byte and Octet Counts Include                                                                                                                                                                                 | Comments                                                                                                                                      |
|-----------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Inbound physical interface  | <b>show interfaces ge-0/3/0 extensive</b>    | Traffic statistics:<br><br>Input bytes: 496 bytes per packet, representing the Layer 2 packet<br><br>MAC statistics:<br><br>Received octets: 500 bytes per packet, representing the Layer 2 packet + 4 bytes  | The additional 4 bytes are for the CRC.                                                                                                       |
| Inbound logical interface   | <b>show interfaces ge-0/3/0.50 extensive</b> | Traffic statistics:<br><br>Input bytes: 478 bytes per packet, representing the Layer 3 packet                                                                                                                 |                                                                                                                                               |
| Outbound physical interface | <b>show interfaces ge-0/0/0 extensive</b>    | Traffic statistics:<br><br>Input bytes: 490 bytes per packet, representing the Layer 3 packet + 12 bytes<br><br>MAC statistics:<br><br>Received octets: 478 bytes per packet, representing the Layer 3 packet | For input bytes, the additional 12 bytes includes 6 bytes for the destination MAC address + 4 bytes for VLAN + 2 bytes for the Ethernet type. |
| Outbound logical interface  | <b>show interfaces ge-0/0/0.50 extensive</b> | Traffic statistics:<br><br>Input bytes: 478 bytes per packet, representing the Layer 3 packet                                                                                                                 |                                                                                                                                               |

## Sample Output

### show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, IQ2)

```

user@host> show interfaces xe-5/0/0 extensive
Physical interface: xe-5/0/0, Enabled, Physical link is Up
  Interface index: 177, SNMP ifIndex: 99, Generation: 178
  Link-level type: Ethernet, MTU: 1518, LAN-PHY mode, Speed: 10Gbps, Loopback:

```

```

None, Source filtering: Enabled,
Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Link flags : None
CoS queues : 8 supported, 4 maximum usable queues
Schedulers : 1024
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:14:f6:b9:f1:f6, Hardware address: 00:14:f6:b9:f1:f6
Last flapped : Never
Statistics last cleared: Never
Traffic statistics:
Input bytes : 6970332384 0 bps
Output bytes : 0 0 bps
Input packets: 81050506 0 pps
Output packets: 0 0 pps
IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Ingress traffic statistics at Packet Forwarding Engine:
Input bytes : 6970299398 0 bps
Input packets: 81049992 0 pps
Drop bytes : 0 0 bps
Drop packets: 0 0 pps
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0,
L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors: 0
Output errors:
Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
FIFO errors: 0, HS link CRC errors: 0,
MTU errors: 0, Resource errors: 0
Ingress queues: 4 supported, 4 in use
Queue counters: Queued packets Transmitted packets Dropped packets

0 best-effort 81049992 81049992 0
1 expedited-fo 0 0 0
2 assured-forw 0 0 0
3 network-cont 0 0 0

Egress queues: 4 supported, 4 in use
Queue counters: Queued packets Transmitted packets Dropped packets

0 best-effort 0 0 0
1 expedited-fo 0 0 0
2 assured-forw 0 0 0
3 network-cont 0 0 0

Active alarms : None
Active defects : None
PCS statistics Seconds
Bit errors 0
Errored blocks 0

```

```

MAC statistics:
Total octets          6970332384
Total packets        81050506
Unicast packets      81050000
Broadcast packets    506
Multicast packets    0
CRC/Align errors     0
FIFO errors          0
MAC control frames   0
MAC pause frames     0
Oversized frames     0
Jabber frames        0
Fragment frames      0
VLAN tagged frames   0
Code violations       0

Filter statistics:
Input packet count    81050506
Input packet rejects  506
Input DA rejects      0
Input SA rejects      0
Output packet count   0
Output packet pad count 0
Output packet error count 0
CAM destination filters: 0, CAM source filters: 0

Packet Forwarding Engine configuration:
Destination slot: 5

CoS information:
Direction : Output
CoS transmit queue   Bandwidth      Buffer Priority Limit
                        %      bps      %      usec
0 best-effort        95    950000000  95      0      low  none
3 network-control    5     50000000   5      0      low  none

Direction : Input
CoS transmit queue   Bandwidth      Buffer Priority Limit
                        %      bps      %      usec
0 best-effort        95    950000000  95      0      low  none
3 network-control    5     50000000   5      0      low  none

Logical interface xe-5/0/0.0 (Index 71) (SNMP ifIndex 95) (Generation 195)
Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.100 ] Encapsulation: ENET2
Egress account overhead: 100
Ingress account overhead: 90

Traffic statistics:
Input bytes : 0
Output bytes : 46
Input packets: 0
Output packets: 1

IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0

Local statistics:
Input bytes : 0
Output bytes : 46
Input packets: 0
Output packets: 1

Transit statistics:
Input bytes : 0
Output bytes : 0

```



```

Input packets:                0                0 pps
Output packets:               0                0 pps
IPv6 transit statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:              0
  Output packets:             0
Protocol inet, MTU: 1500, Generation: 253, Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.1.1/24, Local: 192.1.1.1, Broadcast: 192.1.1.255,
Generation: 265
Protocol multiservice, MTU: Unlimited, Generation: 254, Route table: 0
  Flags: None
  Policer: Input: __default_arp_policer__

```

### show interfaces extensive (10-Gigabit Ethernet, WAN PHY Mode)

```

user@host> show interfaces xe-1/0/0 extensive
Physical interface: xe-1/0/0, Enabled, Physical link is Up
Interface index: 141, SNMP ifIndex: 34, Generation: 47
Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Loopback: Disabled
WAN-PHY mode
Source filtering: Disabled, Flow control: Enabled
Device flags : Present Running
Interface flags: SNMP-Traps 16384
Link flags : None
CoS queues : 4 supported
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:05:85:a2:10:9d, Hardware address: 00:05:85:a2:10:9d
Last flapped : 2005-07-07 11:22:34 PDT (3d 12:28 ago)
Statistics last cleared: Never
Traffic statistics:
  Input bytes :                0                0 bps
  Output bytes :                0                0 bps
  Input packets:              0                0 pps
  Output packets:             0                0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  HS Link CRC errors: 0, HS Link FIFO overflows: 0,
  Resource errors: 0
Output errors:
  Carrier transitions: 1, Errors: 0, Drops: 0, Collisions: 0,
  Aged packets: 0, FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0,
  Resource errors: 0
Queue counters:
  Queued packets  Transmitted packets  Dropped packets
0 best-effort    0                0                0
1 expedited-fo   0                0                0
2 assured-forw   0                0                0
3 network-cont   0                0                0
Active alarms : LOL, LOS, LBL
Active defects: LOL, LOS, LBL, SEF, AIS-L, AIS-P
PCS statistics
  Seconds  Count
Bit errors 0        0
Errored blocks 0      0
MAC statistics:
  Receive  Transmit
Total octets 0        0
Total packets 0        0
Unicast packets 0      0
Broadcast packets 0     0
Multicast packets 0     0

```

```

CRC/Align errors                0                0
FIFO errors                     0                0
MAC control frames              0                0
MAC pause frames                0                0
Oversized frames               0
Jabber frames                  0
Fragment frames                0
VLAN tagged frames             0
Code violations                 0
Filter statistics:
  Input packet count            0
  Input packet rejects          0
  Input DA rejects              0
  Input SA rejects              0
  Output packet count           0
  Output packet pad count       0
  Output packet error count     0
CAM destination filters: 0, CAM source filters: 0
PMA PHY:
  Seconds      Count  State
  PLL lock     0      0 OK
  PHY light    63159  1 Light Missing
WIS section:
  BIP-B1        0      0
  SEF           434430  434438 Defect Active
  LOS           434430  1 Defect Active
  LOF           434430  1 Defect Active
  ES-S          434430
  SES-S         434430
  SEFS-S        434430
WIS line:
  BIP-B2        0      0
  REI-L         0      0
  RDI-L         0      0 OK
  AIS-L         434430  1 Defect Active
  BERR-SF       0      0 OK
  BERR-SD       0      0 OK
  ES-L          434430
  SES-L         434430
  UAS-L         434420
  ES-LFE        0
  SES-LFE       0
  UAS-LFE       0
WIS path:
  BIP-B3        0      0
  REI-P         0      0
  LOP-P         0      0 OK
  AIS-P         434430  1 Defect Active
  RDI-P         0      0 OK
  UNEQ-P        0      0 OK
  PLM-P         0      0 OK
  ES-P          434430
  SES-P         434430
  UAS-P         434420
  ES-PFE        0
  SES-PFE       0
  UAS-PFE       0
Received path trace:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
Transmitted path trace: orissa so-1/0/0
6f 72 69 73 73 61 20 73 6f 2d 31 2f 30 2f 30 00 orissa so-1/0/0.
Packet Forwarding Engine configuration:

```

```

Destination slot: 1
CoS information:
  CoS transmit queue      Bandwidth      Buffer      Priority  Limit
                           %      bps      %      bytes
  0 best-effort           95      950000000  95        0      low      none
  3 network-control       5       50000000  5         0      low      none

```

### show interfaces extensive (10-Gigabit Ethernet, DWDM OTN PIC)

```

user@host> show interfaces ge-7/0/0 extensive
Physical interface: ge-7/0/0, Enabled, Physical link is Down
Interface index: 143, SNMP ifIndex: 508, Generation: 208
Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
Flow control: Enabled
Device flags   : Present Running Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x4000
Link flags    : None
Wavelength    : 1550.12 nm, Frequency: 193.40 THz
CoS queues    : 8 supported, 8 maximum usable queues
Hold-times    : Up 0 ms, Down 0 ms
Current address: 00:05:85:70:2b:72, Hardware address: 00:05:85:70:2b:72
Last flapped  : 2011-04-20 15:48:54 PDT (18:39:49 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes   : 0                      0 bps
Output bytes  : 0                      0 bps
Input packets : 0                      0 pps
Output packets: 0                      0 pps
IPv6 transit statistics:
Input bytes   : 0
Output bytes  : 0
Input packets : 0
Output packets: 0
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
FIFO errors: 0, Resource errors: 0
Output errors:
Carrier transitions: 2, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort           0              0              0

  1 expedited-fo         0              0              0

  2 assured-forw         0              0              0

  3 network-cont
Queue number:      Mapped forwarding classes
  0                best-effort
  1                expedited-forwarding
  2                assured-forwarding
  3                network-control
Active alarms  : LINK
Active defects : LINK
MAC statistics:
Total octets      Receive      Transmit
Total packets     0              0

```

```

Unicast packets                0                0
Broadcast packets              0                0
Multicast packets              0                0
CRC/Align errors               0                0
FIFO errors                    0                0
MAC control frames             0                0
MAC pause frames               0                0
Oversized frames               0
Jabber frames                  0
Fragment frames                0
VLAN tagged frames             0
Code violations                 0
Total octets                    0                0
Total packets                  0                0
Unicast packets                0                0
Broadcast packets              0                0
Multicast packets              0                0
CRC/Align errors               0                0
FIFO errors                    0                0
MAC control frames             0                0
MAC pause frames               0                0
Oversized frames               0
Jabber frames                  0
Fragment frames                0
VLAN tagged frames             0
Code violations                 0
OTN alarms                     :   None
OTN defects                    :   None
OTN FEC Mode                   :   GFEC
OTN Rate                       :   Fixed Stuff Bytes 11.0957Gbps
OTN Line Loopback : Enabled
OTN FEC statistics :
  Corrected Errors              0
  Corrected Error Ratio (      0 sec average)  0e-0
OTN FEC alarms:                Seconds    Count  State
  FEC Degrade                   0          0    OK
  FEC Excessive                 0          0    OK
OTN OC:                        Seconds    Count  State
  LOS                           2          1    OK
  LOF                          67164       2  Defect Active
  LOM                          67164       71  Defect Active
  Wavelength Lock               0          0    OK
OTN OTU:
  AIS                           0          0    OK
  BDI                          65919      4814  Defect Active
  IAE                          67158       1  Defect Active
  TTIM                          7          1    OK
  SF                           67164       2  Defect Active
  SD                           67164       3  Defect Active
  TCA-ES                        0          0    OK
  TCA-SES                       0          0    OK
  TCA-UAS                       80         40    OK
  TCA-BBE                       0          0    OK
  BIP                           0          0    OK
  BBE                           0          0    OK
  ES                            0          0    OK
  SES                           0          0    OK
  UAS                           587         0    OK
Received DAPI:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
Received SAPI:

```

```

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
Transmitted DAPI:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
Transmitted SAPI:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
OTN Received Overhead Bytes:
  APS/PCC0: 0x02, APS/PCC1: 0x42, APS/PCC2: 0xa2, APS/PCC3: 0x48
  Payload Type: 0x03
OTN Transmitted Overhead Bytes:
  APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
  Payload Type: 0x03
Filter statistics:
  Input packet count                0
  Input packet rejects              0
  Input DA rejects                  0
  Input SA rejects                  0
  Output packet count                0
  Output packet pad count            0
  Output packet error count          0
  CAM destination filters: 0, CAM source filters: 0
Packet Forwarding Engine configuration:
  Destination slot: 7
CoS information:
  Direction : Output
  CoS transmit queue      Bandwidth      Buffer Priority
Limit                    %      bps      %      usec      low
  0 best-effort           95      9500000000  95      0
none
  3 network-control       5       500000000   5      0
none
  ...

```

#### show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode)

```

user@host> show interfaces xe-7/0/0 extensive
Physical interface: xe-7/0/0, Enabled, Physical link is Up
  Interface index: 173, SNMP ifIndex: 212, Generation: 174
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps,
  Unidirectional: Enabled,
  Loopback: None, Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  ...

```

#### show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Transmit-Only)

```

user@host> show interfaces xe-7/0/0-tx extensive
Physical interface: xe-7/0/0-tx, Enabled, Physical link is Up
  Interface index: 176, SNMP ifIndex: 137, Generation: 177
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps,
  Unidirectional: Tx-Only
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:05:85:73:e4:83, Hardware address: 00:05:85:73:e4:83
  Last flapped   : 2007-06-01 09:08:19 PDT (3d 02:31 ago)
  Statistics last cleared: Never
Traffic statistics:
  Input bytes :                0                0 bps

```

```

Output bytes :      322891152287160      9627472888 bps
Input packets:      0                    0 pps
Output packets:    328809727380          1225492 pps

...

Filter statistics:
  Output packet count      328810554250
  Output packet pad count      0
  Output packet error count    0
...

Logical interface xe-7/0/0-tx.0 (Index 73) (SNMP ifIndex 138) (Generation 139)

Flags: SNMP-Traps Encapsulation: ENET2
Egress account overhead: 100
Ingress account overhead: 90
Traffic statistics:
  Input bytes :      0
  Output bytes :    322891152287160
  Input packets:      0
  Output packets:    328809727380
IPv6 transit statistics:
  Input bytes :      0
  Output bytes :      0
  Input packets:      0
  Output packets:      0
Local statistics:
  Input bytes :      0
  Output bytes :      0
  Input packets:      0
  Output packets:      0
Transit statistics:
  Input bytes :      0                    0 bps
  Output bytes :    322891152287160      9627472888 bps
  Input packets:      0                    0 pps
  Output packets:    328809727380          1225492 pps
IPv6 transit statistics:
  Input bytes :      0
  Output bytes :      0
  Input packets:      0
  Output packets:      0
Protocol inet, MTU: 1500, Generation: 147, Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 10.11.12/24, Local: 10.11.12.13, Broadcast: 10.11.12.255,
  Generation: 141
Protocol multiservice, MTU: Unlimited, Generation: 148, Route table: 0
  Flags: None
  Policer: Input: __default_arp_policer__

```

#### show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Receive-Only)

```

user@host> show interfaces xe-7/0/0-rx extensive
Physical interface: xe-7/0/0-rx, Enabled, Physical link is Up
  Interface index: 174, SNMP ifIndex: 118, Generation: 175
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps,
  Unidirectional: Rx-Only
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues

```

```

Hold-times      : Up 0 ms, Down 0 ms
Current address: 00:05:85:73:e4:83, Hardware address: 00:05:85:73:e4:83
Last flapped   : 2007-06-01 09:08:22 PDT (3d 02:31 ago)
Statistics last cleared: Never
Traffic statistics:
  Input bytes :      322857456303482      9627496104 bps
  Output bytes :              0          0 bps
  Input packets:      328775413751      1225495 pps
  Output packets:              0          0 pps

...

Filter statistics:
  Input packet count      328775015056
  Input packet rejects    1
  Input DA rejects        0

...

Logical interface xe-7/0/0-rx.0 (Index 72) (SNMP ifIndex 120) (Generation 138)

Flags: SNMP-Traps Encapsulation: ENET2
Traffic statistics:
  Input bytes :      322857456303482
  Output bytes :              0
  Input packets:      328775413751
  Output packets:              0
IPv6 transit statistics:
  Input bytes :              0
  Output bytes :              0
  Input packets:              0
  Output packets:              0
Local statistics:
  Input bytes :              0
  Output bytes :              0
  Input packets:              0
  Output packets:              0
Transit statistics:
  Input bytes :      322857456303482      9627496104 bps
  Output bytes :              0          0 bps
  Input packets:      328775413751      1225495 pps
  Output packets:              0          0 pps
IPv6 transit statistics:
  Input bytes :              0
  Output bytes :              0
  Input packets:              0
  Output packets:              0
Protocol inet, MTU: 1500, Generation: 145, Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.1.1/24, Local: 192.1.1.1, Broadcast: 192.1.1.255,
Generation: 139
  Protocol multiservice, MTU: Unlimited, Generation: 146, Route table: 0
  Flags: None
  Policer: Input: __default_arp_policer__

```

## show interfaces (M Series, MX Series, T Series Routers, and PTX Series Management and Internal Ethernet)

|                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>List of Syntax</b>                                                                               | <a href="#">Syntax (M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface) on page 1628</a><br><a href="#">Syntax (M Series, MX Series, T Series, and PTX Series Routers Internal Ethernet Interface) on page 1628</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Syntax (M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface)</b> | <pre>show interfaces em0   fxp0 &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Syntax (M Series, MX Series, T Series, and PTX Series Routers Internal Ethernet Interface)</b>   | <pre>show interfaces bcm0   em0   em1   fxp1   fxp2   ixgbe0   ixgbe1 &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release Information</b>                                                                          | <p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced on PTX Series Packet Transport Routers for Junos OS Release 12.1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>                                                                                  | (M Series, T Series, TX Matrix Plus, and PTX Series devices only) Display status information about the management Ethernet and internal Ethernet interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Options</b>                                                                                      | <p><b>em0   fxp0</b>—(M Series, MX Series, T Series, and PTX Series) Display standard information about the management Ethernet interface. For supported Ethernet interface by chassis and Routing Engine, see <i>Supported Routing Engines by Router</i>.</p> <p><b>bcm0   em0   em1   fxp1   fxp2   ixgbe0   ixgbe1</b>—(M Series, MX Series, T Series, and PTX Series) Display standard information about the internal Ethernet interfaces. See <i>Supported Routing Engines by Router</i> for the internal Ethernet interface names for each Routing Engine by hardware platform.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Required Privilege Level</b>                                                                     | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



- List of Sample Output**
- [show interfaces brief \(Management Ethernet\) on page 1632](#)
  - [show interfaces \(Management Ethernet\) on page 1632](#)
  - [show interfaces \(Management Ethernet \[TX Matrix Plus Router\]\) on page 1633](#)
  - [show interfaces \(Management Ethernet \[PTX Series Packet Transport Routers\]\) on page 1633](#)
  - [show interfaces detail \(Management Ethernet\) on page 1633](#)
  - [show interfaces detail \(Management Ethernet \[TX Matrix Plus Router\]\) on page 1634](#)
  - [show interfaces detail \(Management Ethernet \[PTX Packet Transport Routers\]\) on page 1635](#)
  - [show interfaces extensive \(Management Ethernet\) on page 1635](#)
  - [show interfaces extensive \(Management Ethernet \[TX Matrix Plus Router\]\) on page 1636](#)
  - [show interfaces extensive \(Management Ethernet \[PTX Series Packet Transport Routers\]\) on page 1637](#)
  - [show interfaces brief \(Management Ethernet\) on page 1638](#)
  - [show interfaces brief \(Management Ethernet \[TX Matrix Plus Router\]\) on page 1638](#)
  - [show interfaces brief \(Management Ethernet \[PTX Series Packet Transport Routers\]\) on page 1638](#)
  - [show interfaces \(Internal Ethernet\) on page 1638](#)
  - [show interfaces \(Internal Ethernet \[TX Matrix Plus Router\]\) on page 1639](#)
  - [show interfaces detail \(Internal Ethernet\) on page 1639](#)
  - [show interfaces detail \(Internal Ethernet \[TX Matrix Plus Router\]\) on page 1640](#)
  - [show interfaces extensive \(internal Ethernet\) on page 1641](#)
  - [show interfaces extensive \(internal Ethernet \[TX Matrix Plus Router\]\) on page 1642](#)

**Output Fields** [Table 103 on page 1629](#) lists the output fields for the **show interfaces** (management) command on the M Series routers, T Series routers, TX Matrix Plus routers, and PTX Series. Output fields are listed in the approximate order in which they appear.

**Table 103: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface**

| Field Name                | Field Description                                                                                                                    | Level of Output              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Physical Interface</b> |                                                                                                                                      |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                      | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> . | All levels                   |
| <b>Interface index</b>    | Physical interface index number, which reflects its initialization sequence.                                                         | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                        | <b>detail extensive none</b> |
| <b>Generation</b>         | Unique number for use by Juniper Networks technical support only.                                                                    | <b>detail extensive</b>      |
| <b>Type</b>               | Type of interface.                                                                                                                   | All levels                   |
| <b>Link-level type</b>    | Encapsulation type used on the physical interface.                                                                                   | All levels                   |
| <b>MTU</b>                | Maximum transmission unit (MTU)—Size of the largest packet to be transmitted.                                                        | All levels                   |

Table 103: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                        | Level of Output              |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Clocking</b>                | Reference clock source of the interface.                                                                                                                                                                                                                                                                                                                                 | All levels                   |
| <b>Speed</b>                   | Network speed on the interface.                                                                                                                                                                                                                                                                                                                                          | All levels                   |
| <b>Device flags</b>            | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                       | All levels                   |
| <b>Interface flags</b>         | Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                          | All levels                   |
| <b>Link type</b>               | Data transmission type.                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive none</b> |
| <b>Link flags</b>              | Information about the link. Possible values are described in the “Link Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                    | <b>detail extensive</b>      |
| <b>Physical info</b>           | Information about the physical interface.                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b>      |
| <b>Hold-times</b>              | Current interface hold-time up and hold-time down. Value is in milliseconds.                                                                                                                                                                                                                                                                                             | <b>detail extensive</b>      |
| <b>Current address</b>         | Configured MAC address.                                                                                                                                                                                                                                                                                                                                                  | <b>detail extensive none</b> |
| <b>Hardware address</b>        | Media access control (MAC) address of the interface.                                                                                                                                                                                                                                                                                                                     | <b>detail extensive none</b> |
| <b>Alternate link address</b>  | Backup link address.                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |
| <b>Last flapped</b>            | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: <i>year-month-day hour:minute:second timezone (hour:minute:second ago)</i></b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> .                                                                                                              | <b>detail extensive none</b> |
| <b>Input packets</b>           | Number of packets received on the physical interface.                                                                                                                                                                                                                                                                                                                    | None specified               |
| <b>Output packets</b>          | Number of packets transmitted on the physical interface.                                                                                                                                                                                                                                                                                                                 | None specified               |
| <b>Statistics last cleared</b> | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b>      |
| <b>Traffic statistics</b>      | <p>Number and rate of bytes and packets received and transmitted on the logical and physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes, Output bytes</b>—Number of bytes received and transmitted on the interface.</li> <li>• <b>Input packets, Output packets</b>—Number of packets received and transmitted on the interface.</li> </ul> | <b>detail extensive</b>      |

Table 103: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Level of Output              |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Input errors</b>      | <ul style="list-style-type: none"> <li>• <b>Errors</b>—Input errors on the interface.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Frames received smaller than the runt threshold.</li> <li>• <b>Giants</b>—Frames received larger than the giant threshold.</li> <li>• <b>Policed Discards</b>—Frames that the incoming packet match code discarded because they were not recognized or were not of interest. Usually, this field reports protocols that Junos does not support.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul>                                                                                                    | <b>extensive</b>             |
| <b>Output errors</b>     | <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly, possibly once every 10 seconds, the cable, the remote system, or the interface is malfunctioning.</li> <li>• <b>Errors</b>—Sum of outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet dropped by the ASIC RED mechanism.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>extensive</b>             |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| <b>Logical interface</b> | Name of the logical interface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | All levels                   |
| <b>Index</b>             | Logical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>      | Logical interface SNMP interface index number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive none</b> |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |
| <b>Flags</b>             | Information about the logical interface; values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All levels                   |
| <b>Encapsulation</b>     | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive none</b> |
| <b>inet</b>              | IP address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>brief</b>                 |
| <b>Protocol</b>          | Protocol family configured on the logical interface (such as <b>iso</b> or <b>inet6</b> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive none</b> |
| <b>MTU</b>               | MTU size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive none</b> |
| <b>Generation</b>        | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |

Table 103: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface (*continued*)

| Field Name              | Field Description                                                                                                                                        | Level of Output       |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Route table</b>      | Route table in which this address exists. For example, <b>Route table:0</b> refers to inet.0.                                                            | detail extensive      |
| <b>Flags</b>            | Information about the protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> . | detail extensive none |
| <b>Addresses, Flags</b> | Information about address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .          | detail extensive none |
| <b>Destination</b>      | IP address of the remote side of the connection.                                                                                                         | detail extensive none |
| <b>Local</b>            | IP address of the logical interface.                                                                                                                     | detail extensive none |
| <b>Broadcast</b>        | Broadcast address.                                                                                                                                       | detail extensive none |
| <b>Generation</b>       | Unique number for use by Juniper Networks technical support only.                                                                                        | detail extensive      |

## Sample Output

### show interfaces brief (Management Ethernet)

```

user@host> show interfaces fxp0 brief
Physical interface: fxp0, Enabled, Physical link is Up
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps

Logical interface fxp0.0
  Flags: SNMP-Traps Encapsulation: ENET2
  inet  192.168.70.143/21

```

### show interfaces (Management Ethernet)

```

user@host> show interfaces fxp0
Physical interface: fxp0, Enabled, Physical link is Up
  Interface index: 1, SNMP ifIndex: 1
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Half-Duplex
  Current address: 00:a0:a5:56:01:89, Hardware address: 00:a0:a5:56:01:89
  Last flapped   : Never
    Input packets : 80804
    Output packets: 1105

Logical interface fxp0.0 (Index 2) (SNMP ifIndex 13)
  Flags: SNMP-Traps Encapsulation: ENET2
  Protocol inet, MTU: 1500
    Flags: Is-Primary
    Addresses, Flags: Is-Preferred Is-Primary

```

```

Destination: 192.168.64/21, Local: 192.168.70.143,
Broadcast: 192.168.71.255

```

### show interfaces (Management Ethernet [TX Matrix Plus Router])

```

user@host> show interfaces em0
Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 17
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Current address: 00:80:f9:26:00:c0, Hardware address: 00:80:f9:26:00:c0
  Last flapped   : Never
    Input packets : 1424
    Output packets: 5282

Logical interface em0.0 (Index 3) (SNMP ifIndex 18)
  Flags: SNMP-Traps Encapsulation: ENET2
  Input packets : 1424
  Output packets: 5282
  Protocol inet, MTU: 1500
    Flags: Is-Primary
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.168.178.0/25, Local: 192.168.178.11, Broadcast:
192.168.178.127

```

### show interfaces (Management Ethernet [PTX Series Packet Transport Routers])

```

user@host> show interfaces em0
Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 0
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Current address: 00:80:f9:25:00:1b, Hardware address: 00:80:f9:25:00:1b
  Last flapped   : Never
    Input packets : 212581
    Output packets: 71

Logical interface em0.0 (Index 3) (SNMP ifIndex 0)
  Flags: SNMP-Traps Encapsulation: ENET2
  Input packets : 212551
  Output packets: 71
  Protocol inet, MTU: 1500
    Flags: Is-Primary
  Addresses, Flags: Is-Default Is-Preferred Is-Primary
    Destination: 192.168.3/24, Local: 192.168.3.30,
Broadcast: 192.168.3.255

```

### show interfaces detail (Management Ethernet)

```

user@host> show interfaces fxp0 detail
Physical interface: fxp0, Enabled, Physical link is Up
  Interface index: 1, SNMP ifIndex: 1, Generation: 0
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Half-Duplex
  Physical info   : Unspecified

```

```

Hold-times      : Up 0 ms, Down 0 ms
Current address: 00:a0:a5:56:01:89, Hardware address: 00:a0:a5:56:01:89
Alternate link address: Unspecified
Last flapped    : Never
Statistics last cleared: Never
Traffic statistics:
  Input bytes :          6484031
  Output bytes :          167503
  Input packets:          81008
  Output packets:         1110

Logical interface fxp0.0 (Index 2) (SNMP ifIndex 13) (Generation 1)
  Flags: SNMP-Traps Encapsulation: ENET2
  Protocol inet, MTU: 1500, Generation: 6, Route table: 0
  Flags: Is-Primary
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.168.64/21, Local: 192.168.70.143,
    Broadcast: 192.168.71.255, Generation: 1

```

### show interfaces detail (Management Ethernet [TX Matrix Plus Router])

```

user@host> show interfaces em0 detail
Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 17, Generation: 2
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:80:f9:26:00:c0, Hardware address: 00:80:f9:26:00:c0
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes :          124351
    Output bytes :         1353212
    Input packets:          1804
    Output packets:         5344
  IPv6 transit statistics:
    Input bytes :           0
    Output bytes :           0
    Input packets:           0
    Output packets:           0

Logical interface em0.0 (Index 3) (SNMP ifIndex 18) (Generation 1)
  Flags: SNMP-Traps Encapsulation: ENET2
  Traffic statistics:
    Input bytes :          117135
    Output bytes :         1331647
    Input packets:          1804
    Output packets:         5344
  Local statistics:
    Input bytes :          117135
    Output bytes :         1331647
    Input packets:          1804
    Output packets:         5344
  Protocol inet, MTU: 1500, Generation: 1, Route table: 0
  Flags: Is-Primary
  Addresses, Flags: Is-Preferred Is-Primary

```

Destination: 192.168.178.0/25, Local: 192.168.178.11, Broadcast:  
192.168.178.127, Generation: 1

### show interfaces detail (Management Ethernet [PTX Packet Transport Routers])

```
user@host> show interfaces detail em0
Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 0, Generation: 3
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,

  Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:80:f9:25:00:1b, Hardware address: 00:80:f9:25:00:1b
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          15255909
    Output bytes  :           4608
    Input packets :          214753
    Output packets:           72
  IPv6 transit statistics:
    Input bytes   :           0
    Output bytes  :           0
    Input packets :           0
    Output packets:           0

  Logical interface em0.0 (Index 3) (SNMP ifIndex 0) (Generation 1)
  Flags: SNMP-Traps Encapsulation: ENET2
  Traffic statistics:
    Input bytes   :          14394630
    Output bytes  :           3024
    Input packets :          214723
    Output packets:           72
  Local statistics:
    Input bytes   :          14394630
    Output bytes  :           3024
    Input packets :          214723
    Output packets:           72
  Protocol inet, MTU: 1500, Generation: 1, Route table: 0
  Flags: Is-Primary
  Addresses, Flags: Is-Default Is-Preferred Is-Primary
    Destination: 192.168.3/24, Local: 192.168.3.30,
    Broadcast: 192.168.3.255, Generation: 1
```

### show interfaces extensive (Management Ethernet)

```
user@host> show interfaces fxp0 extensive
Physical interface: fxp0, Enabled, Physical link is Up
  Interface index: 1, SNMP ifIndex: 1, Generation: 0
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Half-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
```

```

Current address: 00:a0:a5:56:01:89, Hardware address: 00:a0:a5:56:01:89
Alternate link address: Unspecified
Last flapped   : Never
Statistics last cleared: Never
Traffic statistics:
  Input bytes   :          6678904
  Output bytes  :          169657
  Input packets :          83946
  Output packets:          1127
Input errors:
  Errors: 12, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0,
  Policed discards: 0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0,
  Resource errors: 0

Logical interface fxp0.0 (Index 2) (SNMP ifIndex 13) (Generation 1)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500, Generation: 6, Route table: 0
Flags: Is-Primary
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 192.168.64/21, Local: 192.168.70.143,
  Broadcast: 192.168.71.255, Generation: 1

```

#### show interfaces extensive (Management Ethernet [TX Matrix Plus Router])

```
user@host> show interfaces em0 extensive
```

```

Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 17, Generation: 2
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:80:f9:26:00:c0, Hardware address: 00:80:f9:26:00:c0
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          127120
    Output bytes  :          1357414
    Input packets :          1843
    Output packets:          5372
  IPv6 transit statistics:
    Input bytes   :          0
    Output bytes  :          0
    Input packets :          0
    Output packets:          0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
    0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
    0

Logical interface em0.0 (Index 3) (SNMP ifIndex 18) (Generation 1)
Flags: SNMP-Traps Encapsulation: ENET2
Traffic statistics:

```



```

Input bytes :          119748
Output bytes :         1335719
Input packets:          1843
Output packets:         5372
Local statistics:
Input bytes :          119748
Output bytes :         1335719
Input packets:          1843
Output packets:         5372
Protocol inet, MTU: 1500, Generation: 1, Route table: 0
Flags: Is-Primary
Addresses, Flags: Is-Preferred Is-Primary
Destination: 192.168.178.0/25, Local: 192.168.178.11, Broadcast:
192.168.178.127, Generation: 1

```

### show interfaces extensive (Management Ethernet [PTX Series Packet Transport Routers])

```

user@host> show interfaces extensive em0
Physical interface: em0, Enabled, Physical link is Up
  Interface index: 8, SNMP ifIndex: 0, Generation: 3
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,

  Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:80:f9:25:00:1b, Hardware address: 00:80:f9:25:00:1b
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes :          15236459
    Output bytes :           4608
    Input packets:         214482
    Output packets:           72
  IPv6 transit statistics:
Input bytes :          0
Output bytes :          0
Input packets:          0
Output packets:          0
  Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0,
Policed discards: 0, Resource errors: 0
  Output errors:
Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0,
Resource errors: 0

  Logical interface em0.0 (Index 3) (SNMP ifIndex 0) (Generation 1)
  Flags: SNMP-Traps Encapsulation: ENET2
  Traffic statistics:
    Input bytes :         14376264
    Output bytes :           3024
    Input packets:         214452
    Output packets:           72
  Local statistics:
    Input bytes :         14376264
    Output bytes :           3024
    Input packets:         214452
    Output packets:           72

```

```
Protocol inet, MTU: 1500, Generation: 1, Route table: 0
Flags: Is-Primary
Addresses, Flags: Is-Default Is-Preferred Is-Primary
  Destination: 192.168.3/24, Local: 192.168.3.30,
  Broadcast: 192.168.3.255, Generation: 1
```

#### show interfaces brief (Management Ethernet)

```
user@host> show interfaces fxp1 brief
Physical interface: fxp1, Enabled, Physical link is Up
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps

Logical interface fxp1.0
  Flags: SNMP-Traps Encapsulation: ENET2
  inet  10.0.0.4/8
  inet6 fe80::200:ff:fe00:4/64
        fec0::10:0:0:4/64
  tnp   4
```

#### show interfaces brief (Management Ethernet [TX Matrix Plus Router])

```
user@host> show interfaces em0 brief
Physical interface: em0, Enabled, Physical link is Up
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps

Logical interface em0.0
  Flags: SNMP-Traps Encapsulation: ENET2
  inet  192.168.178.11/25
```

#### show interfaces brief (Management Ethernet [PTX Series Packet Transport Routers])

```
user@host> show interfaces em0 brief
Physical interface: em0, Enabled, Physical link is Up
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,

  Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps

  Logical interface em0.0
  Flags: SNMP-Traps Encapsulation: ENET2
  inet  192.168.3.30/24
```

```
root@absolutely> show interfaces em0 terse
Interface      Admin Link Proto  Local      Remote
em0            up    up
em0.0          up    up  inet    192.168.3.30/24
```

#### show interfaces (Internal Ethernet)

```
user@host> show interfaces fxp1
Physical interface: fxp1, Enabled, Physical link is Up
  Interface index: 2, SNMP ifIndex: 2
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 100mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
```

```

Link type      : Full-Duplex
Current address: 02:00:00:00:00:04, Hardware address: 02:00:00:00:00:04
Last flapped   : Never
  Input packets : 30655
  Output packets: 33323

Logical interface fxp1.0 (Index 3) (SNMP ifIndex 14)
  Flags: SNMP-Traps Encapsulation: ENET2
  Protocol inet, MTU: 1500
    Flags: Is-Primary
    Addresses, Flags: Is-Default Is-Preferred Is-Primary
      Destination: 10/8, Local: 10.0.0.4, Broadcast: 10.255.255.255
  Protocol inet6, MTU: 1500
    Flags: Is-Primary
    Addresses, Flags: Is-Preferred
      Destination: fe80::/64, Local: fe80::200:ff:fe00:4
    Addresses, Flags: Is-Default Is-Preferred Is-Primary
      Destination: fec0::/64, Local: fec0::10:0:0:4
  Protocol tnp, MTU: 1500
    Flags: Primary, Is-Primary
    Addresses
      Local: 4

```

#### show interfaces (Internal Ethernet [TX Matrix Plus Router])

```

user@host> show interfaces ixgbe0
Physical interface: ixgbe0, Enabled, Physical link is Up
  Interface index: 2, SNMP ifIndex: 116
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Current address: 02:00:00:22:00:04, Hardware address: 02:00:00:22:00:04
  Last flapped   : Never
    Input packets : 2301738
    Output packets: 3951155

Logical interface ixgbe0.0 (Index 4) (SNMP ifIndex 117)
  Flags: SNMP-Traps Encapsulation: ENET2
  Input packets : 2301595
  Output packets: 3951155
  Protocol inet, MTU: 1500
    Flags: Is-Primary
    Addresses, Flags: Is-Preferred
      Destination: 10/8, Local: 10.34.0.4, Broadcast: 10.255.255.255
    Addresses, Flags: Primary Is-Default Is-Preferred Is-Primary
      Destination: 128/2, Local: 162.0.0.4, Broadcast: 191.255.255.255
  Protocol inet6, MTU: 1500
    Flags: Is-Primary
    Addresses, Flags: Is-Preferred
      Destination: fe80::/64, Local: fe80::200:ff:fe22:4
    Addresses, Flags: Is-Default Is-Preferred Is-Primary
      Destination: fec0::/64, Local: fec0::a:22:0:4
  Protocol tnp, MTU: 1500
    Flags: Primary, Is-Primary
    Addresses
      Local: 0x22000004

```

#### show interfaces detail (Internal Ethernet)

```

user@host> show interfaces fxp1 detail

```

```

Physical interface: fxp1, Enabled, Physical link is Up
Interface index: 2, SNMP ifIndex: 2, Generation: 1
Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: 100mbps
Device flags   : Present Running
Interface flags: SNMP-Traps
Link type      : Full-Duplex
Physical info  : Unspecified
Hold-times     : Up 0 ms, Down 0 ms
Current address: 02:00:00:00:00:04, Hardware address: 02:00:00:00:00:04
Alternate link address: Unspecified
Last flapped   : Never
Statistics last cleared: Never
Traffic statistics:
Input bytes   :          2339969
Output bytes  :          15880707
Input packets :           30758
Output packets:           33443

Logical interface fxp1.0 (Index 3) (SNMP ifIndex 14) (Generation 2)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500, Generation: 7, Route table: 1
Flags: Is-Primary
Addresses, Flags: Is-Default Is-Preferred Is-Primary
Destination: 10/8, Local: 10.0.0.4, Broadcast: 10.255.255.255,
Generation: 3
Protocol inet6, MTU: 1500, Generation: 8, Route table: 1
Flags: Is-Primary
Addresses, Flags: Is-Preferred
Destination: fe80::/64, Local: fe80::200:ff:fe00:4,
Broadcast: Unspecified, Generation: 5
Addresses, Flags: Is-Default Is-Preferred Is-Primary
Destination: fec0::/64, Local: fec0::10:0:0:4, Broadcast: Unspecified,
Generation: 7
Protocol tnp, MTU: 1500, Generation: 9, Route table: 1
Flags: Primary, Is-Primary
Addresses, Flags: None
Destination: Unspecified, Local: 4, Broadcast: Unspecified,
Generation: 8

```

#### show interfaces detail (Internal Ethernet [TX Matrix Plus Router])

```

user@host> show interfaces ixgbe0 detail
Physical interface: ixgbe0, Enabled, Physical link is Up
Interface index: 2, SNMP ifIndex: 116, Generation: 3
Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: 1000mbps
Device flags   : Present Running
Interface flags: SNMP-Traps
Link type      : Full-Duplex
Physical info  : Unspecified
Hold-times     : Up 0 ms, Down 0 ms
Current address: 02:00:00:22:00:04, Hardware address: 02:00:00:22:00:04
Alternate link address: Unspecified
Last flapped   : Never
Statistics last cleared: Never
Traffic statistics:
Input bytes   :          238172825
Output bytes  :          1338948955
Input packets :          2360984
Output packets:          4061512

```

```

IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0

Logical interface ixgbe0.0 (Index 4) (SNMP ifIndex 117) (Generation 2)
Flags: SNMP-Traps Encapsulation: ENET2
Traffic statistics:
Input bytes : 228720309
Output bytes : 1261387447
Input packets: 2360841
Output packets: 4061512
IPv6 transit statistics:
Input bytes : 0
Output bytes : 0
Input packets: 0
Output packets: 0
Local statistics:
Input bytes : 228720309
Output bytes : 1261387447
Input packets: 2360841
Output packets: 4061512
Protocol inet, MTU: 1500, Generation: 2, Route table: 1
Flags: Is-Primary
Addresses, Flags: Is-Preferred
Destination: 10/8, Local: 10.34.0.4, Broadcast: 10.255.255.255, Generation:
2
Addresses, Flags: Primary Is-Default Is-Preferred Is-Primary
Destination: 128/2, Local: 162.0.0.4, Broadcast: 191.255.255.255,
Generation: 3
Protocol inet6, MTU: 1500, Generation: 3, Route table: 1
Flags: Is-Primary
Addresses, Flags: Is-Preferred
Destination: fe80::/64, Local: fe80::200:ff:fe22:4
Generation: 4
Addresses, Flags: Is-Default Is-Preferred Is-Primary
Destination: fec0::/64, Local: fec0::a:22:0:4
Protocol tnp, MTU: 1500, Generation: 5
Generation: 4, Route table: 1
Flags: Primary, Is-Primary
Addresses, Flags: None
Destination: Unspecified, Local: 0x22000004, Broadcast: Unspecified,
Generation: 6

```

#### show interfaces extensive (internal Ethernet)

```

user@host> show interfaces fxp1 extensive
Physical interface: fxp1, Enabled, Physical link is Up
Interface index: 2, SNMP ifIndex: 2, Generation: 1
Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: 100mbps
Device flags : Present Running
Interface flags: SNMP-Traps
Link type : Full-Duplex
Physical info : Unspecified
Hold-times : Up 0 ms, Down 0 ms
Current address: 02:00:00:00:00:04, Hardware address: 02:00:00:00:00:04
Alternate link address: Unspecified
Last flapped : Never
Statistics last cleared: Never

```

```

Traffic statistics:
Input bytes :          2349897
Output bytes :        15888605
Input packets:          30896
Output packets:        33607
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0,
Policed discards: 0, Resource errors: 0
Output errors:
Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0,
Resource errors: 0

Logical interface fxp1.0 (Index 3) (SNMP ifIndex 14) (Generation 2)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500, Generation: 7, Route table: 1
  Flags: Is-Primary
  Addresses, Flags: Is-Default Is-Preferred Is-Primary
    Destination: 10/8, Local: 10.0.0.4, Broadcast: 10.255.255.255,
    Generation: 3
Protocol inet6, MTU: 1500, Generation: 8, Route table: 1
  Flags: Is-Primary
  Addresses, Flags: Is-Preferred
    Destination: fe80::/64, Local: fe80::200:ff:fe00:4,
    Broadcast: Unspecified, Generation: 5
  Addresses, Flags: Is-Default Is-Preferred Is-Primary
    Destination: fec0::/64, Local: fec0::10:0:0:4, Broadcast: Unspecified,
    Generation: 7
Protocol tnp, MTU: 1500, Generation: 9, Route table: 1
  Flags: Primary, Is-Primary
  Addresses, Flags: None
    Destination: Unspecified, Local: 4, Broadcast: Unspecified,
    Generation: 8

```

#### show interfaces extensive (internal Ethernet [TX Matrix Plus Router])

```

user@host> show interfaces ixgbe0 extensive
Physical interface: ixgbe0, Enabled, Physical link is Up
  Interface index: 2, SNMP ifIndex: 116, Generation: 3
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 02:00:00:22:00:04, Hardware address: 02:00:00:22:00:04
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
Traffic statistics:
Input bytes :          242730780
Output bytes :        1348312269
Input packets:          2398737
Output packets:        4133510
IPv6 transit statistics:
Input bytes :          0
Output bytes :          0
Input packets:          0
Output packets:          0
Input errors:
Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:

```

```

0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0

```

```

Logical interface ixgbe0.0 (Index 4) (SNMP ifIndex 117) (Generation 2)
  Flags: SNMP-Traps Encapsulation: ENET2
  Traffic statistics:
    Input bytes :      233127252
    Output bytes :     1269350897
    Input packets:      2398594
    Output packets:     4133510
  IPv6 transit statistics:
    Input bytes :      0
    Output bytes :      0
    Input packets:      0
    Output packets:      0
  Local statistics:
    Input bytes :      233127252
    Output bytes :     1269350897
    Input packets:      2398594
    Output packets:     4133510
  Protocol inet, MTU: 1500, Generation: 2, Route table: 1
    Flags: Is-Primary
    Addresses, Flags: Is-Preferred
      Destination: 10/8, Local: 10.34.0.4, Broadcast: 10.255.255.255, Generation:
2
      Addresses, Flags: Primary Is-Default Is-Preferred Is-Primary
        Destination: 128/2, Local: 162.0.0.4, Broadcast: 191.255.255.255,
Generation: 3
    Protocol inet6, MTU: 1500, Generation: 3, Route table: 1
      Flags: Is-Primary
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::200:ff:fe22:4
Generation: 4
      Addresses, Flags: Is-Default Is-Preferred Is-Primary
        Destination: fec0::/64, Local: fec0::a:22:0:4
    Protocol tnp, MTU: 1500, Generation: 5
    Generation: 4, Route table: 1
      Flags: Primary, Is-Primary
      Addresses, Flags: None
        Destination: Unspecified, Local: 0x22000004, Broadcast: Unspecified,
Generation: 6

```

## show interfaces (PPPoE)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces pp0.logical &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index snmp-index&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | (M120 routers, M320 routers, and MX Series routers only). Display status information about the PPPoE interface.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><b>pp0.logical</b>—Display standard status information about the PPPoE interface.</p> <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>media</b>—(Optional) Display media-specific information about PPPoE interfaces.</p> <p><b>snmp-index snmp-index</b>—(Optional) Display information for the specified SNMP index of the interface.</p> <p><b>statistics</b>—(Optional) Display PPPoE interface statistics.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces (PPPoE) on page 1650</a></p> <p><a href="#">show interfaces (PPPoE over Aggregated Ethernet) on page 1650</a></p> <p><a href="#">show interfaces brief (PPPoE) on page 1650</a></p> <p><a href="#">show interfaces detail (PPPoE) on page 1651</a></p> <p><a href="#">show interfaces extensive (PPPoE on M120 and M320 Routers) on page 1652</a></p>                                                                                                                                                                         |
| <b>Output Fields</b>            | Table 104 on page 1644 lists the output fields for the <b>show interfaces</b> (PPPoE) command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                       |

Table 104: show interfaces (PPPoE) Output Fields

| Field Name                | Field Description                                                                                                                    | Level of Output              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Physical Interface</b> |                                                                                                                                      |                              |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                      | All levels                   |
| <b>Enabled</b>            | State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> . | All levels                   |
| <b>Interface index</b>    | Physical interface index number, which reflects its initialization sequence.                                                         | <b>detail extensive none</b> |
| <b>SNMP ifIndex</b>       | SNMP index number for the physical interface.                                                                                        | <b>detail extensive none</b> |



Table 104: show interfaces (PPPoE) Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                     | Level of Output         |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b> |
| <b>Type</b>                    | Physical interface type (PPPoE).                                                                                                                                                                                                                                                                                                                                                                                                                      | All levels              |
| <b>Link-level type</b>         | Encapsulation on the physical interface (PPPoE).                                                                                                                                                                                                                                                                                                                                                                                                      | All levels              |
| <b>MTU</b>                     | MTU size on the physical interface.                                                                                                                                                                                                                                                                                                                                                                                                                   | All levels              |
| <b>Clocking</b>                | Reference clock source. It can be <b>Internal</b> or <b>External</b> .                                                                                                                                                                                                                                                                                                                                                                                | All levels              |
| <b>Speed</b>                   | Speed at which the interface is running.                                                                                                                                                                                                                                                                                                                                                                                                              | All levels              |
| <b>Device flags</b>            | Information about the physical device. Possible values are described in the "Device Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                    | All levels              |
| <b>Interface flags</b>         | Information about the interface. Possible values are described in the "Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                       | All levels              |
| <b>Link type</b>               | Physical interface link type: <b>full duplex</b> or <b>half duplex</b> .                                                                                                                                                                                                                                                                                                                                                                              | All levels              |
| <b>Link flags</b>              | Information about the interface. Possible values are described in the "Link Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                            | All levels              |
| <b>Input rate</b>              | Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                                                                                                                                                                                                                     | None specified          |
| <b>Output rate</b>             | Output rate in bps and pps.                                                                                                                                                                                                                                                                                                                                                                                                                           | None specified          |
| <b>Physical Info</b>           | Physical interface information.                                                                                                                                                                                                                                                                                                                                                                                                                       | All levels              |
| <b>Hold-times</b>              | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                                                                                                                                                                                                                   | <b>detail extensive</b> |
| <b>Current address</b>         | Configured MAC address.                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive</b> |
| <b>Hardware address</b>        | MAC address of the hardware.                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>detail extensive</b> |
| <b>Alternate link address</b>  | Backup address of the link.                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive</b> |
| <b>Statistics last cleared</b> | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b> |
| <b>Traffic statistics</b>      | Number and rate of bytes and packets received and transmitted on the physical interface. <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | <b>detail extensive</b> |

Table 104: show interfaces (PPPoE) Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Level of Output       |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| IPv6 transit statistics  | <p>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</p> <p><b>NOTE:</b> These fields include dropped traffic and exception traffic, as those fields are not separately defined.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | detail extensive      |
| Input errors             | <p>Input errors on the interface:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Giants</b>—Number of frames received that are larger than the giant threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>Resource errors</b>—Sum of B chip Tx drops and IXP Tx net transmit drops.</li> </ul>                                                                                                            | extensive             |
| Output errors            | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b> —Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), then the cable, the far-end system, or the PIM is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of B chip Tx drops and IXP Tx net transmit drops.</li> </ul> | extensive             |
| <b>Logical Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |
| Logical interface        | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All levels            |
| Index                    | Logical interface index number (which reflects its initialization sequence).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | detail extensive none |
| SNMP ifIndex             | Logical interface SNMP interface index number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | detail extensive none |
| Generation               | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | detail extensive      |

Table 104: show interfaces (PPPoE) Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Level of Output         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Flags</b>                   | Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | All levels              |
| <b>Encapsulation</b>           | Type of encapsulation configured on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | All levels              |
| <b>PPP parameters</b>          | PPP status: <ul style="list-style-type: none"> <li>• LCP restart timer—Length of time (in milliseconds) between successive Link Control Protocol (LCP) configuration requests.</li> <li>• NCP restart timer—Length of time (in milliseconds) between successive Network Control Protocol (NCP) configuration requests.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail</b>           |
| <b>PPPoE</b>                   | PPPoE status: <ul style="list-style-type: none"> <li>• <b>State</b>—State of the logical interface (<b>up</b> or <b>down</b>).</li> <li>• <b>Session ID</b>—PPPoE session ID.</li> <li>• <b>Service name</b>—Type of service required. Can be used to indicate an Internet service provider (ISP) name or a class or quality of service.</li> <li>• <b>Configured AC name</b>—Configured access concentrator name.</li> <li>• <b>Auto-reconnect timeout</b>—Time after which to try to reconnect after a PPPoE session is terminated, in seconds.</li> <li>• <b>Idle Timeout</b>—Length of time (in seconds) that a connection can be idle before disconnecting.</li> <li>• <b>Underlying interface</b>—Interface on which PPPoE is running.</li> </ul> | All levels              |
| <b>Link</b>                    | Name of the physical interfaces for member links in an aggregated Ethernet bundle for a PPPoE over aggregated Ethernet configuration. PPPoE traffic goes out on these interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | All levels              |
| <b>Traffic statistics</b>      | Total number of bytes and packets received and transmitted on the logical interface. These statistics are the sum of the local and transit statistics. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. This counter usually takes less than 1 second to stabilize.                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b> |
| <b>IPv6 transit statistics</b> | Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled. <p><b>NOTE:</b> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                           | <b>detail extensive</b> |
| <b>Local statistics</b>        | Statistics for traffic received from and transmitted to the Routing Engine. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. This counter usually takes less than 1 second to stabilize.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive</b> |

Table 104: show interfaces (PPPoE) Output Fields (*continued*)

| Field Name                  | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Level of Output              |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Transit statistics</b>   | <p>Statistics for traffic transiting the router. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. This counter usually takes less than 1 second to stabilize.</p> <p><b>NOTE:</b> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b>      |
| <b>Keepalive settings</b>   | <p>(PPP and HDLC) Configured settings for keepalives.</p> <ul style="list-style-type: none"> <li><b>interval seconds</b>—The time in seconds between successive keepalive requests. The range is 10 seconds through 32,767 seconds, with a default of 10 seconds.</li> <li><b>down-count number</b>—The number of keepalive packets a destination must fail to receive before the network takes a link down. The range is 1 through 255, with a default of 3.</li> <li><b>up-count number</b>—The number of keepalive packets a destination must receive to change a link's status from down to up. The range is 1 through 255, with a default of 1.</li> </ul>                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |
| <b>Keepalive statistics</b> | <p>(PPP and HDLC) Information about keepalive packets.</p> <ul style="list-style-type: none"> <li><b>Input</b>—Number of keepalive packets received by PPP. <ul style="list-style-type: none"> <li><b>(last seen 00:00:00 ago)</b>—Time the last keepalive packet was received, in the format <i>hh:mm:ss</i>.</li> </ul> </li> <li><b>Output</b>—Number of keepalive packets sent by PPP and how long ago the last keepalive packets were sent and received. <ul style="list-style-type: none"> <li><b>(last seen 00:00:00 ago)</b>—Time the last keepalive packet was sent, in the format <i>hh:mm:ss</i>.</li> </ul> </li> </ul> <p>(MX Series routers with MPCs/MICs) When an MX Series router with MPCs/MICs is using PPP fast keepalive for a PPP link, the display does not include the number of keepalive packets received or sent, or the amount of time since the router received or sent the last keepalive packet.</p> | <b>detail extensive</b>      |
| <b>Input packets</b>        | Number of packets received on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | None specified               |
| <b>Output packets</b>       | Number of packets transmitted on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | None specified               |
| <b>LCP state</b>            | <p>(PPP) Link Control Protocol state.</p> <ul style="list-style-type: none"> <li><b>Conf-ack-received</b>—Acknowledgement was received.</li> <li><b>Conf-ack-sent</b>—Acknowledgement was sent.</li> <li><b>Conf-req-sent</b>—Request was sent.</li> <li><b>Down</b>—LCP negotiation is incomplete (not yet completed or has failed).</li> <li><b>Not-configured</b>—LCP is not configured on the interface.</li> <li><b>Opened</b>—LCP negotiation is successful.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | none <b>detail extensive</b> |

Table 104: show interfaces (PPPoE) Output Fields (*continued*)

| Field Name                    | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Level of Output              |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>NCP state</b>              | (PPP) Network Control Protocol state.<br><br><ul style="list-style-type: none"> <li>• <b>Conf-ack-received</b>—Acknowledgement was received.</li> <li>• <b>Conf-ack-sent</b>—Acknowledgement was sent.</li> <li>• <b>Conf-req-sent</b>—Request was sent.</li> <li>• <b>Down</b>—NCP negotiation is incomplete (not yet completed or has failed).</li> <li>• <b>Not-configured</b>—NCP is not configured on the interface.</li> <li>• <b>Opened</b>—NCP negotiation is successful.</li> </ul>                                                                                                                                                                                                                                                                                                                                    | <b>detail extensive none</b> |
| <b>CHAP state</b>             | (PPP) Displays the state of the Challenge Handshake Authentication Protocol (CHAP) during its transaction.<br><br><ul style="list-style-type: none"> <li>• <b>Chap-Chal-received</b>—Challenge was received but response not yet sent.</li> <li>• <b>Chap-Chal-sent</b>—Challenge was sent.</li> <li>• <b>Chap-Resp-received</b>—Response was received for the challenge sent, but CHAP has not yet moved into the Success state. (Most likely with RADIUS authentication.)</li> <li>• <b>Chap-Resp-sent</b>—Response was sent for the challenge received.</li> <li>• <b>Closed</b>—CHAP authentication is incomplete.</li> <li>• <b>Failure</b>—CHAP authentication failed.</li> <li>• <b>Not-configured</b>—CHAP is not configured on the interface.</li> <li>• <b>Success</b>—CHAP authentication was successful.</li> </ul> | <b>none detail extensive</b> |
| <b>Protocol</b>               | Protocol family configured on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive none</b> |
| <b><i>protocol-family</i></b> | Protocol family configured on the logical interface. If the protocol is <b>inet</b> , the IP address of the interface is also displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>brief</b>                 |
| <b>MTU</b>                    | MTU size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Generation</b>             | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive</b>      |
| <b>Route table</b>            | Routing table in which the logical interface address is located. For example, <b>0</b> refers to the routing table <b>inet.0</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Flags</b>                  | Information about the protocol family flags. Possible values are described in the “Family Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive none</b> |
| <b>Addresses, Flags</b>       | Information about the addresses configured for the protocol family. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Destination</b>            | IP address of the remote side of the connection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive none</b> |
| <b>Local</b>                  | IP address of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive none</b> |
| <b>Broadcast</b>              | Broadcast address.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive none</b> |

## Sample Output

### show interfaces (PPPoE)

```
user@host> show interfaces pp0
Physical interface: pp0, Enabled, Physical link is Up
  Interface index: 128, SNMP ifIndex: 24
  Type: PPPoE, Link-level type: PPPoE, MTU: 1532
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Link type      : Full-Duplex
  Link flags     : None
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)

Logical interface pp0.0 (Index 72) (SNMP ifIndex 72)
  Flags: Hardware-Down Point-To-Point SNMP-Traps 0x4000 Encapsulation: PPPoE
  PPPoE:
    State: SessionDown, Session ID: None,
    Service name: None, Configured AC name: sapphire,
    Auto-reconnect timeout: 100 seconds, Idle timeout: Never,
    Underlying interface: at-5/0/0.0 (Index 70)
  Input packets : 0
  Output packets: 0
  LCP state: Not-configured
  NCP state: inet: Not-configured, inet6: Not-configured, iso: Not-configured,
  mpls: Not-configured
  CHAP state: Closed
    Protocol inet, MTU: 100
    Flags: User-MTU, Negotiate-Address
```

### show interfaces (PPPoE over Aggregated Ethernet)

```
user@host> show interfaces pp0.1073773821
Logical interface pp0.1073773821 (Index 80) (SNMP ifIndex 32584)
  Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: PPPoE
  PPPoE:
    State: SessionUp, Session ID: 1,
    Session AC name: alcor, Remote MAC address: 00:10:94:00:00:01,
    Underlying interface: demux0.100 (Index 88)
  Link:
    ge-1/0/0.32767
    ge-1/0/1.32767
  Input packets : 6
  Output packets: 6
  LCP state: Opened
  NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
  CHAP state: Closed
  PAP state: Success
    Protocol inet, MTU: 1500
    Flags: Sendbroadcast-pkt-to-re
    Addresses, Flags: Is-Primary
    Local: 192.162.22.22
```

### show interfaces brief (PPPoE)

```
user@host> show interfaces pp0 brief
Physical interface: pp0, Enabled, Physical link is Up
  Type: PPPoE, Link-level type: PPPoE, MTU: 1532, Speed: Unspecified
  Device flags   : Present Running
```

Interface flags: Point-To-Point SNMP-Traps

Logical interface pp0.0

Flags: Hardware-Down Point-To-Point SNMP-Traps 0x4000 Encapsulation: PPPoE

PPPoE:

State: SessionDown, Session ID: None,  
Service name: None, Configured AC name: sapphire,  
Auto-reconnect timeout: 100 seconds, Idle timeout: Never,  
Underlying interface: at-5/0/0.0 (Index 70)

inet

### show interfaces detail (PPPoE)

user@host> show interfaces pp0 detail

Physical interface: pp0, Enabled, Physical link is Up

Interface index: 128, SNMP ifIndex: 24, Generation: 9

Type: PPPoE, Link-level type: PPPoE, MTU: 1532, Speed: Unspecified

Device flags : Present Running

Interface flags: Point-To-Point SNMP-Traps

Link type : Full-Duplex

Link flags : None

Physical info : Unspecified

Hold-times : Up 0 ms, Down 0 ms

Current address: Unspecified, Hardware address: Unspecified

Alternate link address: Unspecified

Statistics last cleared: Never

Traffic statistics:

|                 |   |       |
|-----------------|---|-------|
| Input bytes :   | 0 | 0 bps |
| Output bytes :  | 0 | 0 bps |
| Input packets:  | 0 | 0 pps |
| Output packets: | 0 | 0 pps |

Logical interface pp0.0 (Index 72) (SNMP ifIndex 72) (Generation 14)

Flags: Hardware-Down Point-To-Point SNMP-Traps 0x4000 Encapsulation: PPPoE

PPPoE:

State: SessionDown, Session ID: None,  
Service name: None, Configured AC name: sapphire,  
Auto-reconnect timeout: 100 seconds, Idle timeout: Never,  
Underlying interface: at-5/0/0.0 (Index 70)

Traffic statistics:

|                 |   |
|-----------------|---|
| Input bytes :   | 0 |
| Output bytes :  | 0 |
| Input packets:  | 0 |
| Output packets: | 0 |

Local statistics:

|                 |   |
|-----------------|---|
| Input bytes :   | 0 |
| Output bytes :  | 0 |
| Input packets:  | 0 |
| Output packets: | 0 |

Transit statistics:

|                 |   |       |
|-----------------|---|-------|
| Input bytes :   | 0 | 0 bps |
| Output bytes :  | 0 | 0 bps |
| Input packets:  | 0 | 0 pps |
| Output packets: | 0 | 0 pps |

LCP state: Not-configured

NCP state: inet: Not-configured, inet6: Not-configured, iso: Not-configured,

mpls: Not-configured

CHAP state: Closed

Protocol inet, MTU: 100, Generation: 14, Route table: 0

Flags: User-MTU, Negotiate-Address

## show interfaces extensive (PPPoE on M120 and M320 Routers)

```

user@host> show interfaces pp0 extensive
Physical interface: pp0, Enabled, Physical link is Up
  Interface index: 128, SNMP ifIndex: 93, Generation: 129
  Type: PPPoE, Link-level type: PPPoE, MTU: 1532, Speed: Unspecified
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Link type      : Full-Duplex
  Link flags     : None
  Physical info  : Unspecified
  Hold-times    : Up 0 ms, Down 0 ms
  Current address: Unspecified, Hardware address: Unspecified
  Alternate link address: Unspecified
  Statistics last cleared: Never
Traffic statistics:
  Input bytes   :          972192          0 bps
  Output bytes  :          975010          0 bps
  Input packets :          1338          0 pps
  Output packets:          1473          0 pps
IPv6 transit statistics:
  Input bytes   :          0
  Output bytes  :          0
  Input packets :          0
  Output packets:          0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
0,
  Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0

Logical interface pp0.0 (Index 69) (SNMP ifIndex 96) (Generation 194)
  Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: PPPoE
  PPPoE:
    State: SessionUp, Session ID: 26,
    Session AC name: None, AC MAC address: 00:17:cb:48:c8:12,
    Service name: None, Configured AC name: None,
    Auto-reconnect timeout: Never, Idle timeout: Never,
    Underlying interface: ge-3/0/1.0 (Index 67)
Traffic statistics:
  Input bytes   :          252
  Output bytes  :          296
  Input packets :           7
  Output packets:           8
IPv6 transit statistics:
  Input bytes   :          0
  Output bytes  :          0
  Input packets :          0
  Output packets:          0
Local statistics:
  Input bytes   :          252
  Output bytes  :          296
  Input packets :           7
  Output packets:           8
Transit statistics:
  Input bytes   :          0          0 bps
  Output bytes  :          0          0 bps
  Input packets :          0          0 pps
  Output packets:          0          0 pps

```



```
IPv6 transit statistics:
  Input bytes : 0
  Output bytes : 0
  Input packets: 0
  Output packets: 0
Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
Keepalive statistics:
  Input : 1 (last seen 00:00:00 ago)
  Output: 1 (last sent 00:00:03 ago)
LCP state: Opened
NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
CHAP state: Closed
PAP state: Closed
  Protocol inet, MTU: 1492, Generation: 171, Route table: 0
  Flags: None
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.0.12.2, Local: 192.0.12.1, Broadcast: Unspecified,
Generation: 206
```

## show interfaces interface-set (Ethernet Interface Set)

|                                 |                                                                                                                                                                                                                                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show interfaces interface-set <i>interface-set-name</i> &lt;detail   terse&gt;</code>                                                                                                                                                       |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.                                                                                                                                                                                                       |
| <b>Description</b>              | <p>Display information about the specified gigabit or 10-Gigabit Ethernet interface set.</p> <p>You can also use the <b>show interfaces interface-set</b> command to display information about agent circuit identifier (ACI) interface sets.</p> |
| <b>Options</b>                  | <p><b>interface-set <i>interface-set-name</i></b>—Display information about the specified Gigabit Ethernet, 10-Gigabit Ethernet, or ACI interface set.</p> <p><b>detail   terse</b>—(Optional) Display the specified level of output.</p>         |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><a href="#">Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration</a></li> </ul>                                                                                                |
| <b>List of Sample Output</b>    | <a href="#">show interfaces interface-set terse on page 1655</a><br><a href="#">show interfaces interface-set detail on page 1655</a><br><a href="#">show interfaces interface-set (ACI Interface Set) on page 1656</a>                           |
| <b>Output Fields</b>            | <a href="#">Table 105 on page 1654</a> describes the information for the <b>show interfaces interface-set</b> command.                                                                                                                            |

Table 105: Ethernet show interfaces interface-set Output Fields

| Field Name                 | Field Description                                                                                                                                                                                                                                                                                                                                                                                                      | Level of Output    |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Physical Interface</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |
| <b>Interface set</b>       | Name of the interface set or sets.                                                                                                                                                                                                                                                                                                                                                                                     | All levels         |
| <b>Interface set index</b> | <p>Index number of the interface set. For ACI interface sets, the following fields are displayed:</p> <ul style="list-style-type: none"> <li><b>ACI VLAN</b>—ACI interface set that the router uses to create dynamic VLAN subscriber interfaces based on the agent circuit identifier value.</li> <li><b>PPPoE</b>—Dynamic PPPoE subscriber interface that the router creates using the ACI interface set.</li> </ul> | <b>detail none</b> |
| <b>Agent Circuit ID</b>    | For ACI interface sets, string in DHCP or PPPoE control packets that uniquely identifies the subscriber's access node and the DSL line on the access node.                                                                                                                                                                                                                                                             | <b>detail none</b> |
| <b>Max Sessions</b>        | For dynamic PPPoE subscriber interfaces, maximum number of PPPoE logical interfaces that that can be activated on the underlying interface.                                                                                                                                                                                                                                                                            | <b>detail none</b> |

Table 105: Ethernet show interfaces interface-set Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output    |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Max Sessions VSA Ignore</b> | For dynamic PPPoE subscriber interfaces, whether the router is configured to ignore (clear) the PPPoE maximum session value returned by RADIUS in the Max-Clients-Per-Interface Juniper Networks VSA [26-143] and restore the PPPoE maximum session value on the underlying interface to the value configured with the <b>max-sessions</b> statement: <b>Off</b> (default) or <b>On</b> .                                     | <b>detail none</b> |
| <b>Traffic statistics</b>      | Number and rate of bytes and packets received and transmitted on the specified interface set. <ul style="list-style-type: none"> <li><b>Input bytes, Output bytes</b>—Number of bytes and number of bytes per second received and transmitted on the interface set</li> <li><b>Input packets, Output packets</b>—Number of packets and number of packets per second received and transmitted on the interface set.</li> </ul> | <b>detail</b>      |
| <b>Egress queues supported</b> | Total number of egress queues supported on the specified interface set.                                                                                                                                                                                                                                                                                                                                                       | <b>detail</b>      |
| <b>Egress queues in use</b>    | Total number of egress queues used on the specified interface set.                                                                                                                                                                                                                                                                                                                                                            | <b>detail</b>      |
| <b>Queue counters</b>          | <b>Queued packets, Transmitted packets, and Dropped packets</b> statistics for the four forwarding classes.                                                                                                                                                                                                                                                                                                                   | <b>detail</b>      |
| <b>Members</b>                 | List of all interface sets or, for ACI interface sets, list of all subscriber interfaces belonging to the specified ACI interface set.                                                                                                                                                                                                                                                                                        | <b>detail none</b> |

## Sample Output

### show interfaces interface-set terse

```

user@host> show interfaces interface-set terse
Interface set:
  iflset-xe-11/3/0-0
  ge-1/0/1-0
  ge-1/0/1-2

```

### show interfaces interface-set detail

```

user@host> show interfaces interface-set iflset-xe-11/3/0-0 detail
Interface set: iflset-xe-11/3/0-0
Interface set index: 19
Traffic statistics:
  Output bytes :          751017840          401673504 bps
  Output packets:        11044380          738377 pps
Egress queues: 4 supported, 4 in use
Queue counters:
  Queued packets  Transmitted packets  Dropped packets
0 best-effort    211091327          11044380          199995746
1 expedited-fo           0              0              0
2 assured-forw           0              0              0
3 network-cont          0              0              0
Members:
  xe-11/3/0.0

```

### show interfaces interface-set (ACI Interface Set)

```
user@host> show interfaces interface-set
Interface set: aci-1001-demux0.1073741826
Interface set index: 1
  ACI VLAN:
    Agent Circuit ID: aci-ppp-dhcp-dvlan-60
  PPPoE:
    Max Sessions: 3, Max Sessions VSA Ignore: Off
Members:
  pp0.1073741827
```

## show interfaces interface-set queue

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show interfaces interface-set queue <i>interface-set-name</i><br><aggregate   remaining-traffic><br><forwarding-class <i>class-name</i> >                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Display information about the gigabit or 10-Gigabit Ethernet interface set queue. Supported in MX Series routers with enhanced queuing DPCs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Options</b>                  | <p><b><i>interface-set-name</i></b>—(Optional) Display information about the specified gigabit or 10-Gigabit Ethernet interface set. Wildcard values can be used in the interface set name.</p> <p><b>aggregate</b>—(Optional) Display the aggregated queuing statistics of all member logical interfaces for interface sets that have traffic-control profiles configured.</p> <p><b>both-ingress-egress</b>—(Optional) On Gigabit Ethernet Intelligent Queuing 2 (IQ2) PICs, display both ingress and egress queue statistics.</p> <p><b>egress</b>—(Optional) Display egress queue statistics.</p> <p><b>forwarding-class <i>class-name</i></b>—(Optional) Display queuing statistics for the specified forwarding class.</p> <p><b>ingress</b>—(Optional) On Gigabit Ethernet IQ2 PICs, display ingress queue statistics.</p> <p><b>remaining-traffic</b>—(Optional) Display the queuing statistics of all member logical interfaces for interface sets that do not have traffic-control profiles configured.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces interface-set queue (Gigabit Ethernet) on page 1658</a></p> <p><a href="#">show interfaces interface-set queue both-ingress-egress (Enhanced DPC) on page 1659</a></p> <p><a href="#">show interfaces interface-set queue egress (Enhanced DPC) on page 1661</a></p> <p><a href="#">show interfaces interface-set queue forwarding-class (Gigabit Ethernet) on page 1662</a></p> <p><a href="#">show interfaces interface-set queue (Enhanced DPC) on page 1663</a></p> <p><a href="#">show interfaces interface-set queue remaining-traffic (Gigabit Ethernet) on page 1663</a></p>                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Output Fields</b>            | <a href="#">Table 106 on page 1657</a> describes the information for the <b>show interfaces interface-set queue</b> command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

Table 106: Ethernet show interfaces interface-set queue Output Fields

| Field Name                 | Field Description                  | Level of Output |
|----------------------------|------------------------------------|-----------------|
| <b>Physical Interface</b>  |                                    |                 |
| <b>Interface set</b>       | Name of the interface set.         | All levels      |
| <b>Interface set index</b> | Index number of the interface set. | All levels      |

Table 106: Ethernet show interfaces interface-set queue Output Fields (*continued*)

| Field Name                          | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Level of Output |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Forwarding classes supported</b> | Total number of forwarding classes supported on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | All levels      |
| <b>Forwarding classes in use</b>    | Total number of forwarding classes used on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | All levels      |
| <b>Egress queues supported</b>      | Total number of egress queues supported on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | All levels      |
| <b>Egress queues in use</b>         | Total number of egress queues used on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All levels      |
| <b>Ingress queues supported</b>     | Total number of ingress queues supported on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All levels      |
| <b>Ingress queues in use</b>        | Total number of ingress queues used on the specified interface set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | All levels      |
| <b>Queue</b>                        | Egress or ingress queue number for the statistics being displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All levels      |
| <b>Forwarding classes</b>           | Forwarding class name for the statistics being displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All levels      |
| <b>Queued</b>                       | <b>Packet and Byte</b> statistics for the specified queue. <ul style="list-style-type: none"> <li><b>Packets</b>—Number of packets queued and input rate in packets per second.</li> <li><b>Bytes</b>—Number of bytes queued and input rate in bytes per second.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         | All levels      |
| <b>Transmitted</b>                  | <b>Packet and Byte</b> statistics for the specified forwarding class. <ul style="list-style-type: none"> <li><b>Packets</b>—Number of packets transmitted and transmit rate in packets per second.</li> <li><b>Bytes</b>—Number of bytes transmitted and transmit rate in bytes per second.</li> <li><b>Tail-dropped packets</b>—Number of packets tail dropped.</li> <li><b>RED-dropped packets</b>—Number of RED-dropped packets for the <b>low</b>, <b>medium-low</b>, <b>medium-high</b>, and <b>high</b> loss priorities.</li> <li><b>RED-dropped bytes</b>—Number of RED-dropped bytes for the <b>low</b>, <b>medium-low</b>, <b>medium-high</b>, and <b>high</b> loss priorities.</li> </ul> | All levels      |

## Sample Output

### show interfaces interface-set queue (Gigabit Ethernet)

```

user@host> show interfaces interface-set queue ge-2/2/0-0
Interface set: ge-2/2/0-0
Interface set index: 3
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
Queued:
Packets           :           3998482           1 pps

```

```

      Bytes                :                271896884                688 bps
Transmitted:
  Packets                :                1077474                1 pps
  Bytes                  :                73268340                688 bps
Tail-dropped packets :                0                0 pps
RED-dropped packets :                2921008                0 pps
  Low                    :                2921008                0 pps
  Medium-low             :                0                0 pps
  Medium-high            :                0                0 pps
  High                   :                0                0 pps
RED-dropped bytes      :                198628544                0 bps
  Low                    :                198628544                0 bps
  Medium-low             :                0                0 bps
  Medium-high            :                0                0 bps
  High                   :                0                0 bps
Queue: 2, Forwarding classes: assured-forwarding
Queued:
  Packets                :                0                0 pps
  Bytes                  :                0                0 bps
Transmitted:
...

```

#### show interfaces interface-set queue both-ingress-egress (Enhanced DPC)

```

user@host> show interfaces interface-set queue ge-2/2/0-0 both-ingress-egress
Interface set: ge-2/2/0-0
Interface set index: 3
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
Queued:
  Packets                :                185968478                473161 pps
  Bytes                  :                10042313520                204441336 bps
Transmitted:
  Packets                :                5441673                13780 pps
  Bytes                  :                293850342                5952960 bps
Tail-dropped packets :                0                0 pps
RED-dropped packets :                180526772                459372 pps
RED-dropped bytes      :                9748446282                198451512 bps
Queue: 1, Forwarding classes: expedited-forwarding
Queued:
  Packets                :                0                0 pps
  Bytes                  :                0                0 bps
Transmitted:
  Packets                :                0                0 pps
  Bytes                  :                0                0 bps
Tail-dropped packets :                0                0 pps
RED-dropped packets :                0                0 pps
RED-dropped bytes      :                0                0 bps
Queue: 2, Forwarding classes: assured-forwarding
Queued:
  Packets                :                522021472                473602 pps
  Bytes                  :                28190332480                204599944 bps
Transmitted:
  Packets                :                5791772                4055 pps
  Bytes                  :                312755688                1751976 bps
Tail-dropped packets :                0                0 pps
RED-dropped packets :                516227139                469546 pps
RED-dropped bytes      :                27876265560                202843872 bps
Queue: 3, Forwarding classes: network-control
Queued:

```

```

Packets          :          0          0 pps
Bytes            :          0          0 bps
Transmitted:
Packets          :          0          0 pps
Bytes            :          0          0 bps
Tail-dropped packets :          0          0 pps
RED-dropped packets :          0          0 pps
RED-dropped bytes  :          0          0 bps
Forwarding classes: 16 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
Queued:
Packets          :      5417304      13797 pps
Bytes            :    368429508    7506096 bps
Transmitted:
Packets          :      5014996      12769 pps
Bytes            :    341019728    6946560 bps
Tail-dropped packets :          0          0 pps
RED-dropped packets :      402189      1028 pps
Low              :      402189      1028 pps
Medium-low       :          0          0 pps
Medium-high      :          0          0 pps
High             :          0          0 pps
RED-dropped bytes :    27348852    559536 bps
Low              :    27348852    559536 bps
Medium-low       :          0          0 bps
Medium-high      :          0          0 bps
High             :          0          0 bps
Queue: 1, Forwarding classes: expedited-forwarding
Queued:
Packets          :          0          0 pps
Bytes            :          0          0 bps
Transmitted:
Packets          :          0          0 pps
Bytes            :          0          0 bps
Tail-dropped packets :          0          0 pps
RED-dropped packets :          0          0 pps
Low              :          0          0 pps
Medium-low       :          0          0 pps
Medium-high      :          0          0 pps
High             :          0          0 pps
RED-dropped bytes :          0          0 bps
Low              :          0          0 bps
Medium-low       :          0          0 bps
Medium-high      :          0          0 bps
High             :          0          0 bps
Queue: 2, Forwarding classes: assured-forwarding
Queued:
Packets          :      5770534      3963 pps
Bytes            :    396943252    2156144 bps
Transmitted:
Packets          :      3945152      1457 pps
Bytes            :    268270336    792608 bps
Tail-dropped packets :          0          0 pps
RED-dropped packets :      1815141      2506 pps
Low              :      1815141      2506 pps
Medium-low       :          0          0 pps
Medium-high      :          0          0 pps
High             :          0          0 pps
RED-dropped bytes :    123429524    1363536 bps
Low              :    123429524    1363536 bps

```



```

        Medium-low      :          0          0 bps
        Medium-high     :          0          0 bps
        High            :          0          0 bps
Queue: 3, Forwarding classes: network-control
Queued:
  Packets              :          0          0 pps
  Bytes                :          0          0 bps
Transmitted:
  Packets              :          0          0 pps
  Bytes                :          0          0 bps
  Tail-dropped packets :          0          0 pps
  RED-dropped packets  :          0          0 pps
    Low                :          0          0 pps
    Medium-low         :          0          0 pps
    Medium-high        :          0          0 pps
    High               :          0          0 pps
  RED-dropped bytes    :          0          0 bps
    Low                :          0          0 bps
    Medium-low         :          0          0 bps
    Medium-high        :          0          0 bps
    High               :          0          0 bps

```

#### show interfaces interface-set queue egress (Enhanced DPC)

```

user@host> show interfaces interface-set queue ge-2/2/0-0 egress
Interface set: ge-2/2/0-0
Interface set index: 3
Forwarding classes: 16 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
Queued:
  Packets              :      3958253      13822 pps
  Bytes                :     269217592     7519712 bps
Transmitted:
  Packets              :      3665035      12729 pps
  Bytes                :     249222380     6924848 bps
  Tail-dropped packets :          0          0 pps
  RED-dropped packets  :      293091      1093 pps
    Low                :      293091      1093 pps
    Medium-low         :          0          0 pps
    Medium-high        :          0          0 pps
    High               :          0          0 pps
  RED-dropped bytes    :     19930188     594864 bps
    Low                :     19930188     594864 bps
    Medium-low         :          0          0 bps
    Medium-high        :          0          0 bps
    High               :          0          0 bps
Queue: 1, Forwarding classes: expedited-forwarding
Queued:
  Packets              :          0          0 pps
  Bytes                :          0          0 bps
Transmitted:
  Packets              :          0          0 pps
  Bytes                :          0          0 bps
  Tail-dropped packets :          0          0 pps
  RED-dropped packets  :          0          0 pps
    Low                :          0          0 pps
    Medium-low         :          0          0 pps
    Medium-high        :          0          0 pps
    High               :          0          0 pps
  RED-dropped bytes    :          0          0 bps

```

```

        Low                :                0                0 bps
        Medium-low         :                0                0 bps
        Medium-high        :                0                0 bps
        High               :                0                0 bps
Queue: 2, Forwarding classes: assured-forwarding
Queued:
  Packets                :          5350989                3904 pps
  Bytes                  :        368412924            2124048 bps
Transmitted:
  Packets                :          3790469                1465 pps
  Bytes                  :        257751892            796960 bps
  Tail-dropped packets :                0                0 pps
  RED-dropped packets :          1550282                2439 pps
    Low                  :          1550282                2439 pps
    Medium-low           :                0                0 pps
    Medium-high          :                0                0 pps
    High                 :                0                0 pps
  RED-dropped bytes     :        105419176            1327088 bps
    Low                  :        105419176            1327088 bps
    Medium-low           :                0                0 bps
    Medium-high          :                0                0 bps
    High                 :                0                0 bps
Queue: 3, Forwarding classes: network-control
Queued:
  Packets                :                0                0 pps
  Bytes                  :                0                0 bps
Transmitted:
  Packets                :                0                0 pps
  Bytes                  :                0                0 bps
  Tail-dropped packets :                0                0 pps
  RED-dropped packets :                0                0 pps
    Low                  :                0                0 pps
    Medium-low           :                0                0 pps
    Medium-high          :                0                0 pps
    High                 :                0                0 pps
  RED-dropped bytes     :                0                0 bps
    Low                  :                0                0 bps
    Medium-low           :                0                0 bps
    Medium-high          :                0                0 bps
    High                 :                0                0 bps

```

#### show interfaces interface-set queue forwarding-class (Gigabit Ethernet)

```

user@host> show interfaces interface-set queue ge-2/2/0-0 forwarding-class best-effort
Interface set: ge-2/2/0-0
Interface set index: 3
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
Queued:
  Packets                :          101857694            1420083 pps
  Bytes                  :        6927234456            772532320 bps
Transmitted:
  Packets                :          3984693                55500 pps
  Bytes                  :        270959592            30192512 bps
  Tail-dropped packets :                0                0 pps
  RED-dropped packets :          97870952            1364583 pps
    Low                  :          97870952            1364583 pps
    Medium-low           :                0                0 pps
    Medium-high          :                0                0 pps
    High                 :                0                0 pps

```

|                   |   |            |               |
|-------------------|---|------------|---------------|
| RED-dropped bytes | : | 6655225776 | 742339808 bps |
| Low               | : | 6655225776 | 742339808 bps |
| Medium-low        | : | 0          | 0 bps         |
| Medium-high       | : | 0          | 0 bps         |
| High              | : | 0          | 0 bps         |

### show interfaces interface-set queue (Enhanced DPC)

```

user@host> show interfaces interface-set queue ge-2/2/0-0 ingress
Interface set: foo
Interface set index: 3
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets      :      149036817      473711 pps
    Bytes        :      8048003934     204642936 bps
  Transmitted:
    Packets      :      4360749        13891 pps
    Bytes        :     235480446       6000912 bps
    Tail-dropped packets :      0      0 pps
    RED-dropped packets :     144676035    459820 pps
    RED-dropped bytes  :     7812506592  198642024 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets      :      0      0 pps
    Bytes        :      0      0 bps
  Transmitted:
    Packets      :      0      0 pps
    Bytes        :      0      0 bps
    Tail-dropped packets :      0      0 pps
    RED-dropped packets :      0      0 pps
    RED-dropped bytes  :      0      0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets      :      485089207      473605 pps
    Bytes        :     26195987476     204597576 bps
  Transmitted:
    Packets      :      5480799        3959 pps
    Bytes        :     295963146       1710504 bps
    Tail-dropped packets :      0      0 pps
    RED-dropped packets :     479605853    469646 pps
    RED-dropped bytes  :     25898716170  202887072 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets      :      0      0 pps
    Bytes        :      0      0 bps
  Transmitted:
    Packets      :      0      0 pps
    Bytes        :      0      0 bps
    Tail-dropped packets :      0      0 pps
    RED-dropped packets :      0      0 pps
    RED-dropped bytes  :      0      0 bps

```

### show interfaces interface-set queue remaining-traffic (Gigabit Ethernet)

```

user@host> show interfaces interface-set queue ge-2/2/0-0 remaining-traffic
Interface set: ge-2/2/0-0
Interface set index: 12
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use

```

Queue: 0, Forwarding classes: best-effort

Queued:

|         |   |           |       |
|---------|---|-----------|-------|
| Packets | : | 2201552   | 0 pps |
| Bytes   | : | 149705536 | 0 bps |

Transmitted:

|                      |   |           |       |
|----------------------|---|-----------|-------|
| Packets              | : | 609765    | 0 pps |
| Bytes                | : | 41464020  | 0 bps |
| Tail-dropped packets | : | 0         | 0 pps |
| RED-dropped packets  | : | 1591787   | 0 pps |
| Low                  | : | 1591787   | 0 pps |
| Medium-low           | : | 0         | 0 pps |
| Medium-high          | : | 0         | 0 pps |
| High                 | : | 0         | 0 pps |
| RED-dropped bytes    | : | 108241516 | 0 bps |
| Low                  | : | 108241516 | 0 bps |
| Medium-low           | : | 0         | 0 bps |
| Medium-high          | : | 0         | 0 bps |
| High                 | : | 0         | 0 bps |

## show interfaces interval

|                                 |                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show interfaces interval<br><interface-name>                                                                                                                                                                                            |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                         |
| <b>Description</b>              | Display the channel service unit (CSU) interface alarm and error count in 15-minute intervals for the past 24 hours. If the system has been operational for less than 24 hours, the maximum number of intervals available is displayed. |
| <b>Options</b>                  | <i>interface-name</i> —(Optional) Name of a particular interface.                                                                                                                                                                       |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                    |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear interfaces interval on page 1263</a></li> </ul>                                                                                                                              |
| <b>List of Sample Output</b>    | <a href="#">show interfaces interval (Channelized OC12) on page 1667</a><br><a href="#">show interfaces interval (E3) on page 1667</a><br><a href="#">show interfaces interval (SONET/SDH) on page 1667</a>                             |
| <b>Output Fields</b>            | Table 107 on page 1665 lists the output fields for the <b>show interfaces interval</b> command. Output fields are listed in the approximate order in which they appear.                                                                 |

**Table 107: show interfaces interval Output Fields**

| Field Name                 | Field Description                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical interface         | Name of the interface.                                                                                                                                                                                                                                                                                                                                        |
| SNMP ifIndex               | SNMP index number for the physical interface.                                                                                                                                                                                                                                                                                                                 |
| hh:mm-current              | Time of day (in hours and minutes) at the beginning of the latest counter interval. The value of the latest counter interval is always less than 15 minutes.                                                                                                                                                                                                  |
| hh:mm-hh:mm                | Time of day (in hours and minutes) at the beginning and end of each 15-minute interval.                                                                                                                                                                                                                                                                       |
| alarm or event: n          | Count of alarms and events within each 15-minute interval. The specific alarm or event depends on the interface media type. For a description of the alarm or event listed, see the <i>interface-type media</i> field (for example, <b>T1 media</b> ) under the <b>show interfaces</b> command for the particular interface type in which you are interested. |
| Interval Total             | Sum of all the alarm and defect counters for the last 24-hour period.                                                                                                                                                                                                                                                                                         |
| Current Day Interval Total | Sum of all the alarm and defect counters in the current day.<br><br><b>NOTE:</b> Starting with Junos OS Release 15.1R3, the <b>Current Day Interval</b> output field is reset after 24 hours.                                                                                                                                                                 |

Table 107: show interfaces interval Output Fields (*continued*)

| Field Name                         | Field Description                                             |
|------------------------------------|---------------------------------------------------------------|
| <b>Previous Day Interval Total</b> | Sum of all the alarm and defect counters in the previous day. |
| <b>Previous Day Interval Total</b> | Sum of all the alarm and defect counters in the previous day. |

---

## Sample Output

### show interfaces interval (Channelized OC12)

```

user@host> show interfaces interval t3-0/3/0:0
Physical interface: t3-0/3/0:0, SNMP ifIndex: 23
  17:43-current:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:28-17:43:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:13-17:28:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:58-17:13:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:43-16:58:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    ...
Interval Total:
  LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
  CES: 230, CSES: 230, SEFS: 230, UAS: 238

```

### show interfaces interval (E3)

```

user@host> show interfaces interval e3-0/3/0
Physical interface: e3-0/3/0, SNMP ifIndex: 23
  17:43-current:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:28-17:43:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  17:13-17:28:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:58-17:13:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    SEFS: 0, UAS: 0
  16:43-16:58:
    LCV: 0, PCV: 0, CCV: 0, LES: 0, PES: 0, PSES: 0, CES: 0, CSES: 0,
    ....
Interval Total:
  LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
  CES: 230, CSES: 230, SEFS: 230, UAS: 238

```

### show interfaces interval (SONET/SDH)

```

user@host> show interfaces interval so-2/2/0
Physical interface: so-2/2/0, SNMP ifIndex: 553
  02:53-current:
    ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
    0, UAS-P: 0
  02:38-02:53:
    ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
    0, UAS-P: 0
  02:23-02:38:
    ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
    0, UAS-P: 0

```

```
02:08-02:23:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
01:53-02:08:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
01:38-01:53:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
01:23-01:38:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
01:08-01:23:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
00:53-01:08:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
00:38-00:53:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
....
Current Day Interval Total:
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
Previous Day Interval Total (Last updated at 02:23):
  ES-S: 0, SES-S: 0, SEFS-S: 0, ES-L: 0, SES-L: 0, UAS-L: 0, ES-P: 0, SES-P:
0, UAS-P: 0
```



## show interfaces irb

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show interfaces irb &lt;brief   detail   extensive   terse&gt; &lt;descriptions&gt; &lt;media&gt; &lt;snmp-index <i>snmp-index</i>&gt; &lt;statistics&gt;</pre>                                                                                                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | Display integrated routing and bridging interfaces information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p><b>brief   detail   extensive   terse</b>—(Optional) Display the specified level of output.</p> <p><b>descriptions</b>—(Optional) Display interface description strings.</p> <p><b>mac</b>—Display hardware MAC address</p> <p><b>media</b>—(Optional) Display media-specific information about network interfaces.</p> <p><b>snmp-index <i>snmp-index</i></b>—(Optional) Display information for the interface with the specified SNMP index.</p> <p><b>statistics</b>—(Optional) Display static interface statistics.</p> |
| <b>Additional Information</b>   | Integrated routing and bridging (IRB) provides simultaneous support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route local packets to another routed interface or to another bridging domain that has a Layer 3 protocol configured.                                                                                                                                                                                                                                                |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>List of Sample Output</b>    | <a href="#">show interfaces irb extensive on page 1673</a><br><a href="#">show interfaces irb snmp-index on page 1674</a>                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Output Fields</b>            | <a href="#">Table 108 on page 1669</a> lists the output fields for the <b>show interfaces irb</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                             |

**Table 108: show interfaces irb Output Fields**

| Field Name                | Field Description                                                                                                                             | Level of Output |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Physical Interface</b> |                                                                                                                                               |                 |
| <b>Physical interface</b> | Name of the physical interface.                                                                                                               | All levels      |
| <b>Enabled</b>            | State of the physical interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> . | All levels      |
| <b>Proto</b>              | Protocol configured on the interface.                                                                                                         | <b>terse</b>    |

Table 108: show interfaces irb Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                          | Level of Output             |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Interface index         | Physical interface index number, which reflects its initialization sequence.                                                                                                                                                                               | detail extensive none       |
| SNMP ifIndex            | SNMP index number for the physical interface.                                                                                                                                                                                                              | detail extensive none       |
| Type                    | Physical interface type.                                                                                                                                                                                                                                   | detail extensive none       |
| Link-level type         | Encapsulation being used on the physical interface.                                                                                                                                                                                                        | detail extensive brief none |
| MTU                     | MTU size on the physical interface.                                                                                                                                                                                                                        | detail extensive brief none |
| Clocking                | Reference clock source: <b>Internal</b> or <b>External</b> . Always unspecified on IRB interfaces.                                                                                                                                                         | detail extensive brief      |
| Speed                   | Speed at which the interface is running. Always unspecified on IRB interfaces.                                                                                                                                                                             | detail extensive brief      |
| Device flags            | Information about the physical device. Possible values are described in the "Device Flags" section under <i>Common Output Fields Description</i> .                                                                                                         | detail extensive brief none |
| Interface flags         | Information about the interface. Possible values are described in the "Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                            | detail extensive brief none |
| Link type               | Physical interface link type: <b>full duplex</b> or <b>half duplex</b> .                                                                                                                                                                                   | detail extensive none       |
| Link flags              | Information about the link. Possible values are described in the "Links Flags" section under <i>Common Output Fields Description</i> .                                                                                                                     | detail extensive none       |
| Physical Info           | Physical interface information.                                                                                                                                                                                                                            | All levels                  |
| Hold-times              | Current interface hold-time up and hold-time down, in milliseconds.                                                                                                                                                                                        | detail extensive            |
| Current address         | Configured MAC address.                                                                                                                                                                                                                                    | detail extensive none       |
| Hardware address        | MAC address of the hardware.                                                                                                                                                                                                                               | detail extensive none       |
| Alternate link address  | Backup address of the link.                                                                                                                                                                                                                                | detail extensive            |
| Last flapped            | Date, time, and how long ago the interface went from down to up. The format is <b>Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago)</b> . For example, <b>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</b> . | detail extensive none       |
| Statistics last cleared | Time when the statistics for the interface were last set to zero.                                                                                                                                                                                          | detail extensive            |

Table 108: show interfaces irb Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Level of Output         |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Traffic statistics</b>      | <p>Number and rate of bytes and packets received and transmitted on the physical interface.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b> |
| <b>IPv6 transit statistics</b> | <p>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</p> <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive</b> |
| <b>Input errors</b>            | <p>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Errors</b>—Sum of the incoming frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>Framing errors</b>—Number of packets received with an invalid frame checksum (FCS).</li> <li>• <b>Runts</b>—Number of frames received that are smaller than the runt threshold.</li> <li>• <b>Giants</b>—Number of frames received that are larger than the giant threshold.</li> <li>• <b>Policed discards</b>—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul>           | <b>detail extensive</b> |
| <b>Output errors</b>           | <p>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</p> <ul style="list-style-type: none"> <li>• <b>Carrier transitions</b>—Number of times the interface has gone from <b>down</b> to <b>up</b>. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the DPC is malfunctioning.</li> <li>• <b>Errors</b>—Sum of the outgoing frame aborts and FCS errors.</li> <li>• <b>Drops</b>—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</li> <li>• <b>MTU errors</b>—Number of packets whose size exceeded the MTU of the interface.</li> <li>• <b>Resource errors</b>—Sum of transmit drops.</li> </ul> | <b>detail extensive</b> |

#### Logical Interface

Table 108: show interfaces irb Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Level of Output                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Logical interface</b>       | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All levels                      |
| <b>Index</b>                   | Index number of the logical interface (which reflects its initialization sequence).                                                                                                                                                                                                                                                                                                                                                                                                             | <b>detail extensive</b><br>none |
| <b>SNMP ifIndex</b>            | SNMP interface index number of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>detail extensive</b><br>none |
| <b>Generation</b>              | Unique number for use by Juniper Networks technical support only.                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive</b>         |
| <b>Flags</b>                   | Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b>         |
| <b>Encapsulation</b>           | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>detail extensive</b>         |
| <b>Bandwidth</b>               | Speed at which the interface is running.                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b>         |
| <b>Routing Instance</b>        | Routing instance IRB is configured under.                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>detail extensive</b>         |
| <b>Bridging Domain</b>         | Bridging domain IRB is participating in.                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b>         |
| <b>Traffic statistics</b>      | Number and rate of bytes and packets received and transmitted on the logical interface. <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul>                                             | <b>detail extensive</b>         |
| <b>IPv6 transit statistics</b> | Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled. <ul style="list-style-type: none"> <li>• <b>Input bytes</b>—Number of bytes received on the interface.</li> <li>• <b>Output bytes</b>—Number of bytes transmitted on the interface.</li> <li>• <b>Input packets</b>—Number of packets received on the interface.</li> <li>• <b>Output packets</b>—Number of packets transmitted on the interface.</li> </ul> | <b>detail extensive</b>         |
| <b>Local statistics</b>        | Statistics for traffic received from and transmitted to the Routing Engine.                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>         |
| <b>Transit statistics</b>      | Statistics for traffic transiting the router.                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>detail extensive</b>         |
| <b>Protocol</b>                | Protocol family configured on the local interface. Possible values are described in the "Protocol Field" section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b>         |
| <b>MTU</b>                     | Maximum transmission unit size on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>detail extensive</b>         |
| <b>Maximum labels</b>          | Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b><br>none |

Table 108: show interfaces irb Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                               | Level of Output         |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Generation</b>       | Unique number for use by Juniper Networks technical support only.                                                                                               | <b>detail extensive</b> |
| <b>Route table</b>      | Routing table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.                                             | <b>detail extensive</b> |
| <b>Addresses, Flags</b> | Information about address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .                 | <b>detail extensive</b> |
| <b>Policer</b>          | The policer that is to be evaluated when packets are received or transmitted on the interface.                                                                  | <b>detail extensive</b> |
| <b>Flags</b>            | Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under <i>Common Output Fields Description</i> . | <b>detail extensive</b> |

## Sample Output

### show interfaces irb extensive

```

user@host> show interfaces irb extensive
Physical interface: irb, Enabled, Physical link is Up
  Interface index: 129, SNMP ifIndex: 23, Generation: 130
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
  Speed: Unspecified
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Link flags     : None
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 02:00:00:00:00:30, Hardware address: 02:00:00:00:00:30
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   : 0
    Output bytes  : 0
    Input packets : 0
    Output packets: 0
  IPv6 transit statistics:
    Input bytes   : 0
    Output bytes  : 0
    Input packets : 0
    Output packets: 0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runt: 0, Giants: 0, Policed discards:
0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
0

Logical interface irb.0 (Index 68) (SNMP ifIndex 70) (Generation 143)
  Flags: Hardware-Down SNMP-Traps 0x4000 Encapsulation: ENET2
  Bandwidth: 1000mbps
  Routing Instance: customer_0 Bridging Domain: bd0

```

```

Traffic statistics:
  Input bytes : 0
  Output bytes : 0
  Input packets: 0
  Output packets: 0
IPv6 transit statistics:
  Input bytes : 0
  Output bytes : 0
  Input packets: 0
  Output packets: 0
Local statistics:
  Input bytes : 0
  Output bytes : 0
  Input packets: 0
  Output packets: 0
Transit statistics:
  Input bytes : 0 0 bps
  Output bytes : 0 0 bps
  Input packets: 0 0 pps
  Output packets: 0 0 pps
IPv6 transit statistics:
  Input bytes : 0
  Output bytes : 0
  Input packets: 0
  Output packets: 0
Protocol inet, MTU: 1500, Generation: 154, Route table: 0
  Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
    Destination: 10.51.1/24, Local: 10.51.1.2, Broadcast: 10.51.1.255,
    Generation: 155
Protocol multiservice, MTU: 1500, Generation: 155, Route table: 0
  Flags: Is-Primary
  Policer: Input: __default_arp_policer

```

#### show interfaces irb snmp-index

```

user@host> show interfaces snmp-index 25
Physical interface: irb, Enabled, Physical link is Up
  Interface index: 128, SNMP ifIndex: 25
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514
  Device flags : Present Running
  Interface flags: SNMP-Traps
  Link type : Full-Duplex
  Link flags : None
  Current address: 02:00:00:00:00:30, Hardware address: 02:00:00:00:00:30
  Last flapped : Never
    Input packets : 0
    Output packets: 0

Logical interface irb.0 (Index 68) (SNMP ifIndex 70)
  Flags: Hardware-Down SNMP-Traps 0x4000 Encapsulation: ENET2
  Bandwidth: 1000mbps
  Routing Instance: customer_0 Bridging Domain: bd0
  Input packets : 0
  Output packets: 0
  Protocol inet, MTU: 1500
    Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
      Destination: 10.51.1/24, Local: 10.51.1.2, Broadcast: 10.51.1.255
  Protocol multiservice, MTU: 1500
    Flags: Is-Primary

```

## show interfaces mac-database

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show interfaces mac-database (ge-fpc/pic/port   ge-fpc/pic/port.n   aex  xe-fpc/pic/port   xe-fpc/pic/port.n   et-fpc/pic/port   et-fpc/pic/port.n) &lt;mac-address mac-address&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | <p>Command introduced before Junos OS Release 7.4.</p> <p>Command introduced on PTX Series Packet Transport Routers for Junos OS Release 12.1.</p> <p>Support for statement with the <b>aex</b> option introduced in Junos OS Release 15.1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | (M Series, T Series, MX Series routers, and PTX Series Packet Transport Routers only)<br>Display media access control (MAC) address information for the specified interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Options</b>                  | <p><b>ge-fpc/pic/port</b>—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.</p> <p><b>ge-fpc/pic/port.n</b>—Display MAC addresses that have been learned on a particular logical interface.</p> <p><b>aex</b>—Display MAC addresses that have been learned on a particular aggregated Ethernet interface.</p> <p><b>xe-fpc/pic/port</b>—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.</p> <p><b>xe-fpc/pic/port.n</b>—Display MAC addresses that have been learned on a particular logical interface.</p> <p><b>et-fpc/pic/port</b>—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.</p> <p><b>et-fpc/pic/port.n</b>—Display MAC addresses that have been learned on a particular logical interface.</p> <p><b>mac-address mac-address</b>—(Optional) Display detailed MAC address statistics, including policer information for <b>ge</b>, <b>xe</b>, and <b>et</b> interfaces.</p> |
| <b>Additional Information</b>   | On IQ2 PIC interfaces, the default value for maximum retention of entries in the MAC address table has changed, for cases in which the table is not full. The new holding time is 12 hours. The previous retention time of 3 minutes is still in effect when the table is full.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces mac-database (All MAC Addresses on a Port) on page 1677</a></p> <p><a href="#">show interfaces mac-database (All MAC Addresses on an Aggregated Ethernet Interface) on page 1678</a></p> <p><a href="#">show interfaces mac-database (All MAC Addresses on a Service) on page 1679</a></p> <p><a href="#">show interfaces mac-database mac-address on page 1679</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**Output Fields** [Table 109 on page 1676](#) lists the output fields for the **show interfaces mac-database** command. Output fields are listed in the approximate order in which they appear.

**Table 109: show interfaces mac-database Output Fields**

| Field Name                      | Field Description                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Physical Interface</b>       |                                                                                                                                                                                                                                                                                                                         |
| <b>Physical interface</b>       | Name of the physical interface.                                                                                                                                                                                                                                                                                         |
| <b>Enabled</b>                  | State of the physical interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .                                                                                                                                                                           |
| <b>Interface index</b>          | Physical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                            |
| <b>SNMP ifIndex</b>             | SNMP index number for the physical interface.                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | Description and name of the interface.                                                                                                                                                                                                                                                                                  |
| <b>Link-level type</b>          | Encapsulation being used on the physical interface.                                                                                                                                                                                                                                                                     |
| <b>MTU</b>                      | MTU size on the physical interface.                                                                                                                                                                                                                                                                                     |
| <b>Speed</b>                    | Speed at which the interface is running.                                                                                                                                                                                                                                                                                |
| <b>Loopback</b>                 | Whether loopback is enabled and the type of loopback: <b>local</b> or <b>remote</b> .                                                                                                                                                                                                                                   |
| <b>Source filtering</b>         | Whether source filtering is configured.                                                                                                                                                                                                                                                                                 |
| <b>Flow control</b>             | Whether flow control is enabled or disabled.                                                                                                                                                                                                                                                                            |
| <b>Minimum links needed</b>     | (Aggregated Ethernet interfaces only) Number of child links that must be operational for the aggregated interface to be operational.                                                                                                                                                                                    |
| <b>Minimum bandwidth needed</b> | (Aggregated Ethernet interfaces only) Minimum amount of bandwidth of child links that must be operational for the aggregated interface to be operational.                                                                                                                                                               |
| <b>Device flags</b>             | Information about the physical device. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                      |
| <b>Current address</b>          | (Aggregated Ethernet interfaces only) Configured MAC address.                                                                                                                                                                                                                                                           |
| <b>Hardware address</b>         | (Aggregated Ethernet interfaces only) Hardware MAC address.                                                                                                                                                                                                                                                             |
| <b>Last flapped</b>             | (Aggregated Ethernet interfaces only) Date, time, and how long ago the interface went from down to up or from up to down. The format is <b>Last flapped: year-month-day hours:minutes:seconds timezone (wwksddays hours:minutes ago)</b> . For example, <b>Last flapped: 2013-12-18 04:33:22 PST (1w5d 22:23 ago)</b> . |
| <b>Input Rate</b>               | (Aggregated Ethernet interfaces only) Input rate in bits per second (bps) and packets per second (pps).                                                                                                                                                                                                                 |



Table 109: show interfaces mac-database Output Fields (*continued*)

| Field Name                                                                 | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Output Rate</b>                                                         | (Aggregated Ethernet interfaces only) Output rate in bps and pps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Interface flags</b>                                                     | Information about the interface. Possible values are described in the “Links Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Link flags</b>                                                          | Information about the link. Possible values are described in the “Device Flags” section under <i>Common Output Fields Description</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Logical Interface</b>                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Logical interface</b>                                                   | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Index</b>                                                               | Logical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>SNMP ifIndex</b>                                                        | Logical interface SNMP interface index number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Flags</b>                                                               | Information about the logical interface (possible values are described in the “Logical Interface Flags” section under <i>Common Output Fields Description</i> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Encapsulation</b>                                                       | Encapsulation on the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>MAC address, Input frames, Input bytes, Output frames, Output bytes</b> | MAC address and corresponding number of input frames, input bytes, output frames, and output bytes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Number of MAC addresses</b>                                             | Number of MAC addresses configured.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Policer Statistics</b>                                                  | <p>(Displayed for <b>mac-address</b> option for <b>ge</b>, <b>xe</b>, and <b>et</b> interface types only) Display information about policers applied to a logical interface-MAC pair.</p> <ul style="list-style-type: none"> <li>• <b>Policer type</b>—Type of policer that is out of spec with respect to the configuration. It can be one or more of the following: <ul style="list-style-type: none"> <li>• <b>Input premium</b>—Number of high-priority rating out-of-spec frames or bytes received.</li> <li>• <b>Output premium</b>—Number of high-priority rating out-of-spec frames or bytes sent.</li> <li>• <b>Input aggregate</b>—Total number of out-of-spec frames or bytes received.</li> <li>• <b>Output aggregate</b>—Total number of out-of-spec frames or bytes sent.</li> </ul> </li> <li>• <b>Discarded Frames</b>—Number of discarded frames.</li> <li>• <b>Discarded Bytes</b>—Number of discarded bytes.</li> </ul> |

## Sample Output

### show interfaces mac-database (All MAC Addresses on a Port)

```

user@host> show interfaces mac-database xe-0/3/3
Physical interface: xe-0/3/3, Enabled, Physical link is Up
  Interface index: 372, SNMP ifIndex: 788
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps, Loopback:
None, Source filtering: Disabled, Flow control: Enabled

```

```

Device flags   : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Link flags     : None

```

Logical interface xe-0/3/3.0 (Index 364) (SNMP ifIndex 829)

Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2

| MAC address       | Input frames | Input bytes | Output frames | Output bytes |
|-------------------|--------------|-------------|---------------|--------------|
| 00:00:00:00:00:00 | 1            | 56          | 0             | 0            |
| 00:00:c0:01:01:02 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:03 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:04 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:05 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:06 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:07 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:08 | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:09 | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:0a | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:0b | 7023809      | 323095214   | 0             | 0            |
| 00:00:c8:01:01:02 | 30424784     | 1399540064  | 37448598      | 1722635508   |
| 00:00:c8:01:01:03 | 30424784     | 1399540064  | 37448598      | 1722635508   |
| 00:00:c8:01:01:04 | 30424716     | 1399536936  | 37448523      | 1722632058   |
| 00:00:c8:01:01:05 | 30424789     | 1399540294  | 37448598      | 1722635508   |
| 00:00:c8:01:01:06 | 30424788     | 1399540248  | 37448597      | 1722635462   |
| 00:00:c8:01:01:07 | 30424783     | 1399540018  | 37448597      | 1722635462   |
| 00:00:c8:01:01:08 | 30424783     | 1399540018  | 37448596      | 1722635416   |
| 00:00:c8:01:01:09 | 8836796      | 406492616   | 8836795       | 406492570    |
| 00:00:c8:01:01:0a | 30424712     | 1399536752  | 37448521      | 1722631966   |
| 00:00:c8:01:01:0b | 30424715     | 1399536890  | 37448523      | 1722632058   |

Number of MAC addresses : 21

#### show interfaces mac-database (All MAC Addresses on an Aggregated Ethernet Interface)

```
user@host> show interfaces mac-database ae4
```

Physical interface: ae4, Enabled, Physical link is Up

Interface index: 132, SNMP ifIndex: 588

Description: Member links xe-0/2/0

Link-level type: Ethernet, MTU: 9188, Speed: Unspecified, BPDU Error: None,  
MAC-REWRITE Error: None, Loopback: Disabled,

Source filtering: Disabled, Flow control: Disabled, Minimum links needed: 1,  
Minimum bandwidth needed: 0

Device flags : Present Running

Interface flags: Interface flags: SNMP-Traps Internal: 0x4000

Current address: 00:22:83:76:ff:c4, Hardware address: 00:22:83:76:ff:c4

Last flapped : 2013-12-18 04:33:22 PST (1w5d 22:23 ago)

Input rate : 62756384 bps (85266 pps)

Output rate : 62759472 bps (85272 pps)

Logical interface ae4.0 (Index 334) (SNMP ifIndex 647)

Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2

| MAC address       | Input frames | Input bytes | Output frames | Output bytes |
|-------------------|--------------|-------------|---------------|--------------|
| 00:00:00:aa:00:02 | 23888711     | 2627758118  | 300           | 22200        |
| 00:00:00:aa:00:03 | 0            | 0           | 0             | 0            |
| 00:00:00:aa:00:04 | 0            | 0           | 0             | 0            |

Number of MAC addresses : 3

### show interfaces mac-database (All MAC Addresses on a Service)

```

user@host> show interfaces mac-database xe-0/3/3
Logical interface xe-0/3/3.0 (Index 364) (SNMP ifIndex 829)
Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2

```

| MAC address       | Input frames | Input bytes | Output frames | Output bytes |
|-------------------|--------------|-------------|---------------|--------------|
| 00:00:00:00:00:00 | 1            | 56          | 0             | 0            |
| 00:00:c0:01:01:02 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:03 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:04 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:05 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:06 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:07 | 7023810      | 323095260   | 0             | 0            |
| 00:00:c0:01:01:08 | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:09 | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:0a | 7023809      | 323095214   | 0             | 0            |
| 00:00:c0:01:01:0b | 7023809      | 323095214   | 0             | 0            |
| 00:00:c8:01:01:02 | 31016568     | 1426762128  | 38040381      | 1749857526   |
| 00:00:c8:01:01:03 | 31016568     | 1426762128  | 38040382      | 1749857572   |
| 00:00:c8:01:01:04 | 31016499     | 1426758954  | 38040306      | 1749854076   |
| 00:00:c8:01:01:05 | 31016573     | 1426762358  | 38040381      | 1749857526   |
| 00:00:c8:01:01:06 | 31016573     | 1426762358  | 38040381      | 1749857526   |
| 00:00:c8:01:01:07 | 31016567     | 1426762082  | 38040380      | 1749857480   |
| 00:00:c8:01:01:08 | 31016567     | 1426762082  | 38040379      | 1749857434   |
| 00:00:c8:01:01:09 | 9428580      | 433714680   | 9428580       | 433714680    |
| 00:00:c8:01:01:0a | 31016496     | 1426758816  | 38040304      | 1749853984   |
| 00:00:c8:01:01:0b | 31016498     | 1426758908  | 38040307      | 1749854122   |

### show interfaces mac-database mac-address

```

user@host> show interfaces mac-database xe-0/3/3 mac-address 00:00:c8:01:01:09
Physical interface: xe-0/3/3, Enabled, Physical link is Up
  Interface index: 372, SNMP ifIndex: 788
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps, Loopback:
None, Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None

Logical interface xe-0/3/3.0 (Index 364) (SNMP ifIndex 829)
Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2
MAC address: 00:00:c8:01:01:09, Type: Configured,
  Input bytes   : 202324652
  Output bytes  : 202324560
  Input frames  : 4398362
  Output frames : 4398360
Policer statistics:
Policer type   Discarded frames  Discarded bytes
Output aggregate      3992386        183649756

```

## show interfaces mc-ae

|                                 |                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show interfaces mc-ae</b><br><revertive-info><br><id <i>identifier</i> unit <i>number</i> >                                                                                                                                                                                                         |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.<br><b>revertive-info</b> statement introduced in Junos OS Release 13.3                                                                                                                                                                                     |
| <b>Description</b>              | On MX Series routers with multichassis aggregated Ethernet ( <b>aeX</b> ) interfaces, display information about the <b>aeX</b> interfaces.                                                                                                                                                             |
| <b>Options</b>                  | <b>revertive-info</b> —(Optional) Display revertive mode information for multichassis aggregated Ethernet interface.<br><br><b>identifier</b> —(Optional) Identifier of the multichassis aggregated Ethernet interface.<br><br><b>number</b> —(Optional) Specify the logical interface by unit number. |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                   |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring Multichassis Link Aggregation on MX Series Routers</i></li> </ul>                                                                                                                                                                              |
| <b>List of Sample Output</b>    | <a href="#">show interfaces mc-ae on page 1681</a><br><a href="#">show interfaces mc-ae (Active/Active Bridging and VRRP over IRB on MX Series Routers) on page 1681</a><br><a href="#">show interfaces mc-ae revertive-info on page 1682</a>                                                          |
| <b>Output Fields</b>            | Table 110 on page 1680 lists the output fields for the <b>show interfaces mc-ae</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                   |

**Table 110: show interfaces mc-ae Output Fields**

| Output Field Name   | Field Description                                                                           |
|---------------------|---------------------------------------------------------------------------------------------|
| <b>Member Link</b>  | Identifiers of the configured multichassis link aggregate interfaces configured interfaces. |
| <b>Local Status</b> | Status of the local link: <b>active</b> or <b>standby</b> .                                 |
| <b>Peer Status</b>  | Status of the peer link: <b>active</b> or <b>standby</b> .                                  |
| <b>Local State</b>  | Up or down state of the local device.                                                       |

Table 110: show interfaces mc-ae Output Fields (*continued*)

| Output Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Peer State</b>                | <p>Status of the local and peer links in an <b>active/active</b> bridge or VRRP over integrated routing and bridging (IRB) configuration on MX Series routers, including:</p> <p>Logical Interface—Aggregated Ethernet (AE) aggregate number and unit number.</p> <p>Topology Type—The bridge or VRRP topology type configured on the AE.</p> <p>Local State—Up or down state of the local device.</p> <p>Peer State—Up or down state of the peer device.</p> <p>Peer Ip/ICL-PL/State—Address, interface and state of the peer device.</p> |
| <b>Logical Interface</b>         | Identifier and unit of the multichassis aggregated Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Core Facing Interface</b>     | Label: <b>pseudowire interface</b> or <b>Ethernet interface</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>ICL-PL</b>                    | Label: <b>pseudowire interface</b> or <b>Ethernet interface</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>switchover mode</b>           | The configured switchover mode for the multichassis aggregated Ethernet interface: <b>revertive</b> or <b>non-revertive</b> .                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>switchover status</b>         | Status of the switchover if the <b>revert-time</b> statement is configured at the <b>[edit interfaces aex mc-ae]</b> hierarchy level.                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>revert time</b>               | Revert time configured for the multichassis aggregated Ethernet interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>switchover time remaining</b> | Seconds left to trigger the switchover if the switchover is in progress.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## Sample Output

### show interfaces mc-ae

```

user@host> show interfaces mc-ae ae0 unit 512
  Member Links   : ae0
  Local Status   : active
  Peer Status    : active
  Logical Interface      : ae0.512
  Core Facing Interface : Label Ethernet Interface
  ICL-PL          : Label Ethernet Interface

```

### show interfaces mc-ae (Active/Active Bridging and VRRP over IRB on MX Series Routers)

```

user@host# show interfaces mc-ae ge-0/0/0.0
  Member Link      : ae0
  Current State Machine's State: active

```

```
Local Status      : active
Local State       : up
Peer Status       : active
Peer State        : up
  Logical Interface : ae0.0
  Topology Type    : bridge
  Local State      : up
  Peer State       : up
  Peer Ip/ICL-PL/State : 192.168.100.10 ge-0/0/0.0 up
```

#### show interfaces mc-ae revertive-info

```
user@host> show interfaces mc-ae revertive-info id 2
Member Link      : ae1
Current State Machine's State: mcae active state
Local Status     : active
Local State      : up
Peer Status      : standby
Peer State       : up
Switchover Mode  : Non Revertive
Switchover Status : N/A
Revert Time      : 1 Minutes
Switchover Remaining Time : N/A
  Logical Interface : ae1.1024
  Topology Type    : bridge
  Local State      : up
  Peer State       : up
  Peer Ip/MCP/State : N/A
```

## show interfaces transport pm

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show interfaces transport pm (all   optics   otn) (all   current   currentday   interval   previousday) (all   <i>interface-name</i> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Command introduced in Junos OS Release 14.2 on the PTX Series.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Description</b>              | Display diagnostic data, warnings, and alarms for transport performance monitoring interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Options</b>                  | <p>(all   optics   otn)—Display both optics and OTN information or either only optics or only OTN information.</p> <p>(all   current   currentday   interval   previousday)—Display information for the current 15-minute interval, the current day, the ninety-six 15-minute intervals, and the previous day; information only for the current 15-minute interval; information only for the current 24 hours; information only for the ninety-six 15-minute intervals; information only for the previous day.</p> <p>(all   <i>interface-name</i>)—Display information for all interfaces or only for the specified interface (for example, <i>et-fpc/pic/port</i>).</p>                  |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear interfaces transport pm on page 1268</a></li> <li>• <a href="#">tca on page 1201</a></li> <li>• <a href="#">transport-monitoring on page 1219</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>List of Sample Output</b>    | <p><a href="#">show interfaces transport pm on page 1685</a></p> <p><a href="#">show interfaces transport (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1686</a></p> <p><a href="#">show interfaces transport pm (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1686</a></p> <p><a href="#">show interfaces transport (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 1687</a></p> <p><a href="#">show interfaces transport pm optics (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 1687</a></p> <p><a href="#">show interfaces transport pm otn (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 1688</a></p> |
| <b>Output Fields</b>            | Table 111 on page 1683 lists the output fields for the <b>show interfaces transport pm optics</b> command. Fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Table 111: show interfaces transport pm Output Fields

| Field Name         | Field Description               |
|--------------------|---------------------------------|
| Physical interface | Name of the physical interface. |

Table 111: show interfaces transport pm Output Fields (*continued*)

| Field Name                    | Field Description                                                                                                    |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Interval                      | The 15 minute interval for performance monitoring.                                                                   |
| Suspect Flag                  | TRUE if the performance monitoring data for the interval appears to                                                  |
| Reason                        | Reason for setting the suspect flag.                                                                                 |
| COUNT                         | Measured value.                                                                                                      |
| THRESHOLD                     | Threshold value set.                                                                                                 |
| TCA-ENABLED                   | Threshold crossing alert. Set to TRUE if enabled.                                                                    |
| TCA-RAISED                    | TRUE if enabled and the value crosses the threshold.                                                                 |
| Near End PM                   | Near end threshold crossing defect trigger. For more information about                                               |
| Far End PM                    | Far end threshold crossing defect trigger. For more information about                                                |
| FEC PM                        | Forwarding equivalence class threshold crossing defect trigger. For more information about see <a href="#">tca</a> . |
| BER PM                        | Bit error rate threshold crossing defect trigger. For more information about                                         |
| CURRENT                       | Current value measured.                                                                                              |
| PM                            | Performance monitor.                                                                                                 |
| MIN                           | Minimum value measured.                                                                                              |
| MAX                           | Maximum value measured.                                                                                              |
| AVG                           | Average value.                                                                                                       |
| Lane Chromatic dispersion     | Residual chromatic dispersion measured.                                                                              |
| Lane differential group delay | Measured differential group delay.                                                                                   |
| q Value                       | Measured Quality factor value.                                                                                       |
| SNR                           | Signal to noise ratio.                                                                                               |
| Tx output power               | The transmit laser output power.                                                                                     |
| Rx input power                | The laser's received optical power.                                                                                  |
| Module temperature (Celsius)  | The laser's temperature.                                                                                             |



Table 111: show interfaces transport pm Output Fields (*continued*)

| Field Name                     | Field Description                                                                              |
|--------------------------------|------------------------------------------------------------------------------------------------|
| Tx Laser bias current (0.1mA)  | Magnitude of the laser bias power setting current. The laser bias prov and modulates currents. |
| Rx Laser bias current (0.1mA)  | Magnitude of the laser bias power setting current.                                             |
| Carrier frequency offset (MHz) | Measured carrier frequency offset.                                                             |

## Sample Output

### show interfaces transport pm

```

user@host> show interfaces transport pm all current et-0/1/0
Physical interface: et-0/1/0, SNMP ifIndex 515
14:45-current Elapse time:900 Seconds
Near End Suspect Flag:False Reason:None
PM COUNT THRESHOLD TCA-ENABLED TCA-RAISED
OTU-BBE 0 800 No No
OTU-ES 0 135 No No
OTU-SES 0 90 No No
OTU-UAS 427 90 No No
Far End Suspect Flag:True Reason:Unknown
PM COUNT THRESHOLD TCA-ENABLED TCA-RAISED
OTU-BBE 0 800 No No
OTU-ES 0 135 No No
OTU-SES 0 90 No No
OTU-UAS 0 90 No No
Near End Suspect Flag:False Reason:None
PM COUNT THRESHOLD TCA-ENABLED TCA-RAISED
ODU-BBE 0 800 No No
ODU-ES 0 135 No No
ODU-SES 0 90 No No
ODU-UAS 427 90 No No
Far End Suspect Flag:True Reason:Unknown
PM COUNT THRESHOLD TCA-ENABLED TCA-RAISED
ODU-BBE 0 800 No No
ODU-ES 0 135 No No
ODU-SES 0 90 No No
ODU-UAS 0 90 No No
FEC Suspect Flag:False Reason:None
PM COUNT THRESHOLD TCA-ENABLED TCA-RAISED
FEC-CorrectedErr 2008544300 0 NA NA
FEC-UncorrectedWords 0 0 NA NA
BER Suspect Flag:False Reason:None
PM MIN MAX AVG THRESHOLD TCA-ENABLED
TCA-RAISED
BER 3.6e-5 5.8e-5 3.6e-5 10.0e-3 No
Yes
Physical interface: et-0/1/0, SNMP ifIndex 515
14:45-current
Suspect Flag:True Reason:Object Disabled

```

| PM                            |       | CURRENT    |       | MIN   | MAX   | AVG   | THRESHOLD |
|-------------------------------|-------|------------|-------|-------|-------|-------|-----------|
| TCA-ENABLED                   |       | TCA-RAISED |       |       |       |       | (MIN)     |
| (MAX)                         | (MIN) | (MAX)      | (MIN) | (MAX) |       |       |           |
| Lane chromatic dispersion     | 0     | NA         | NA    | 0     | 0     | 0     | 0         |
| Lane differential group delay | 0     | NA         | NA    | 0     | 0     | 0     | 0         |
| q Value                       | 0     | NA         | NA    | 120   | 120   | 120   | 0         |
| SNR                           | 0     | NA         | NA    | 28    | 28    | 29    | 0         |
| Tx output power(0.01dBm)      | -100  | No         | No    | -5000 | -5000 | -5000 | -300      |
| Rx input power(0.01dBm)       | -500  | No         | No    | -3642 | -3665 | -3626 | -1800     |
| Module temperature(Celsius)   | 75    | No         | No    | 46    | 46    | 46    | -5        |
| Tx laser bias current(0.1mA)  | 0     | NA         | NA    | 0     | 0     | 0     | 0         |
| Rx laser bias current(0.1mA)  | 0     | NA         | NA    | 1270  | 1270  | 1270  | 0         |
| Carrier frequency offset(MHz) | 5000  | No         | No    | -186  | -186  | -186  | -5000     |

#### show interfaces transport (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```

user@host > show interfaces transport et-3/0/0
Administrative State:    In Service
Operational State:      Normal

```

#### show interfaces transport pm (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```

user@host > show interfaces transport pm otn current et-3/0/0
Physical interface: et-3/0/0, SNMP ifIndex 564
23:30-current Elapsed time:455 Seconds
Near End      Suspect Flag:False Reason:Not Applicable
PM            COUNT          THRESHOLD    TCA-ENABLED  TCA-RAISED

OTU-BBE       0          800          No           No
OTU-ES        0          135          No           No
OTU-SES       0          90           No           No
OTU-UAS       0          90           No           No
Far End      Suspect Flag:False Reason:Not Applicable
PM            COUNT          THRESHOLD    TCA-ENABLED  TCA-RAISED

OTU-BBE       0          800          No           No
OTU-ES        0          135          No           No
OTU-SES       0          90           No           No
OTU-UAS       0          90           No           No
Near End      Suspect Flag:False Reason:Not Applicable
PM            COUNT          THRESHOLD    TCA-ENABLED  TCA-RAISED

ODU-BBE       0          800          No           No
ODU-ES        0          135          No           No
ODU-SES       0          90           No           No
ODU-UAS       0          90           No           No
Far End      Suspect Flag:False Reason:Not Applicable
PM            COUNT          THRESHOLD    TCA-ENABLED  TCA-RAISED

ODU-BBE       0          800          No           No

```

```

ODU-ES          0          135          No          No
ODU-SES         0          90           No          No
ODU-UAS         0          90           No          No
FEC             Suspect Flag:False          Reason:Not Applicable
PM              COUNT          THRESHOLD    TCA-ENABLED    TCA-RAISED

FEC-CorrectedErr 30865849    0          NA          NA
FEC-UncorrectedWords 0          0          NA          NA
BER             Suspect Flag:False          Reason:Not Applicable
PM              MIN          MAX          AVG          THRESHOLD    TCA-ENABLED
TCA-RAISED
BER             4.0e-7    5.9e-7    5.1e-7    1.0e-2    No
No

```

user@host > show interfaces transport pm optics current et-2/0/0

Physical interface: et-3/0/0, SNMP ifIndex 564

23:30-current

Suspect Flag:True

Reason:Not Applicable

```

PM              CURRENT    MIN          MAX          AVG          THRESHOLD
TCA-ENABLED    TCA-RAISED

(MIN)
(MAX) (MIN) (MAX) (MIN) (MAX)
Lane chromatic dispersion(ps/nm) 0          0          0          51          0
0          NA          NA          NA          NA
Lane differential group delay(ps) -13        13          0          11          0
0          NA          NA          NA          NA
q Value(0.1dB) 0          0          -1          5          137          0
0          NA          NA          NA          NA
SNR(0.1dB) 0          137        138        137        86          0
0          NA          NA          NA          NA
Tx output power(0.01dBm) 83          95          83          142        -300
-100        No          No          No          No
Rx input power(0.01dBm) 141         142         141         106        -1800
-500        No          No          No          No
Module temperature(Celsius) 106         109         106         -31        -5
75          No          No          No          No
Tx laser bias current(0.1mA) -31         0          0          38          0
0          NA          NA          NA          NA
Rx laser bias current(0.1mA) 38          38          38          0          0
0          NA          NA          NA          NA
Carrier frequency offset(MHz) 0          0          2          0          -5000
5000        No          No          No          No

```

#### show interfaces transport (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC)

user@host > show interfaces transport et-8/0/0

Administrative State: In Service

Operational State: Normal

#### show interfaces transport pm optics (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC)

user@host > show interfaces transport pm optics current et-4/0/0

Physical interface: et-4/0/0, SNMP ifIndex 544

02:45-current

Suspect Flag:False

Reason:Not Applicable

```

PM              CURRENT    MIN          MAX          AVG          THRESHOLD
TCA-ENABLED    TCA-RAISED

(MIN)
(MAX) (MIN) (MAX) (MIN) (MAX)
Lane chromatic dispersion(ps/nm) -6          -32         45          -1          0
0          NA          NA          NA          NA

```

|                                   |     |     |     |     |       |
|-----------------------------------|-----|-----|-----|-----|-------|
| Lane differential group delay(ps) | 3   | 2   | 4   | 3   | 0     |
| 0                                 | NA  | NA  | NA  | NA  |       |
| Lane Q2 factor(0.1dB)             | 154 | 154 | 155 | 154 | 0     |
| 0                                 | NA  | NA  | NA  | NA  |       |
| SNR(0.1dB)                        | 167 | 164 | 171 | 165 | 0     |
| 0                                 | NA  | NA  | NA  | NA  |       |
| Carrier frequency offset(MHz)     | 0   | 0   | 0   | 0   | -3600 |
| 3600                              | No  | No  | No  | No  |       |
| Tx output power(0.01dBm)          | 0   | 0   | 0   | 0   | -1100 |
| 300                               | No  | No  | No  | No  |       |
| Rx input total power(0.01dBm)     | 0   | 0   | 0   | 0   | -3000 |
| 300                               | No  | No  | No  | No  |       |
| Module temperature(Celsius)       | 53  | 53  | 55  | 53  | -5    |
| 75                                | No  | No  | No  | No  |       |

#### show interfaces transport pm otn (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC)

```
user@host> show interfaces transport pm otn previousday et-4/0/0
```

```
Physical interface: et-4/0/0, SNMP ifIndex 544
```

```
02:45-current
```

```
Suspect Flag:False
```

```
Reason:Not Applicable
```

```
PM
```

```
CURRENT
```

```
MIN
```

```
MAX
```

```
AVG
```

```
THRESHOLD
```

```
TCA-ENABLED
```

```
TCA-RAISED
```

```
(MIN)
```

| (MAX)                             | (MIN) | (MAX) | (MIN) | (MAX) |       |  |  |  |
|-----------------------------------|-------|-------|-------|-------|-------|--|--|--|
| Lane chromatic dispersion(ps/nm)  | -6    | -32   | 45    | -1    | 0     |  |  |  |
| 0                                 | NA    | NA    | NA    | NA    |       |  |  |  |
| Lane differential group delay(ps) | 3     | 2     | 4     | 3     | 0     |  |  |  |
| 0                                 | NA    | NA    | NA    | NA    |       |  |  |  |
| Lane Q2 factor(0.1dB)             | 154   | 154   | 155   | 154   | 0     |  |  |  |
| 0                                 | NA    | NA    | NA    | NA    |       |  |  |  |
| SNR(0.1dB)                        | 167   | 164   | 171   | 165   | 0     |  |  |  |
| 0                                 | NA    | NA    | NA    | NA    |       |  |  |  |
| Carrier frequency offset(MHz)     | 0     | 0     | 0     | 0     | -3600 |  |  |  |
| 3600                              | No    | No    | No    | No    |       |  |  |  |
| Tx output power(0.01dBm)          | 0     | 0     | 0     | 0     | -1100 |  |  |  |
| 300                               | No    | No    | No    | No    |       |  |  |  |
| Rx input total power(0.01dBm)     | 0     | 0     | 0     | 0     | -3000 |  |  |  |
| 300                               | No    | No    | No    | No    |       |  |  |  |
| Module temperature(Celsius)       | 53    | 53    | 55    | 53    | -5    |  |  |  |
| 75                                | No    | No    | No    | No    |       |  |  |  |

## show l2-learning instance

|                                 |                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show l2-learning instance</b>                                                                                                                                                             |
| <b>Release Information</b>      | (MX Series routers only) Command introduced in Junos OS Release 8.4.                                                                                                                         |
| <b>Description</b>              | Display Layer 2 learning properties for all the configured routing instances.                                                                                                                |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                 |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <a href="#">show l2-learning instance on page 1689</a>                                                                                                                                       |
| <b>Output Fields</b>            | <a href="#">Table 112 on page 1689</a> describes the output fields for the <b>show l2-learning instance</b> command. Output fields are listed in the approximate order in which they appear. |

Table 112: show l2-learning instance Output Fields

| Field Name                    | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Routing Instance</b>       | Name of routing instance.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Bridging Domain</b>        | Name of bridging domain.<br><br>On MX Series routers you can use the <b>show l2-learning instance &lt;extensive&gt;</b> command option to display the Bridge Service-id information which includes the Config Service ID and the Active Service ID.                                                                                                                                                                                                              |
| <b>Index</b>                  | Number associated with the routing instance or bridging domain.                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Logical System</b>         | Name of logical system or <b>Default</b> if no logical system is configured.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Routing instance flags</b> | Status of Layer 2 learning properties for each routing instance: <ul style="list-style-type: none"> <li>• <b>DL</b>—MAC learning is disabled.</li> <li>• <b>SE</b>—MAC accounting is enabled.</li> <li>• <b>AD</b>—Packets are dropped after MAC address limit is reached.</li> <li>• <b>LH</b>—The maximum number of MAC addresses has been learned on the routing instance. The routing instance is not able to learn any additional MAC addresses.</li> </ul> |
| <b>MAC limit</b>              | Maximum number of MAC addresses that can be learned from each interface in the routing instance or bridging domain.                                                                                                                                                                                                                                                                                                                                              |

## Sample Output

### show l2-learning instance

```
user@host> show l2-learning instance
Information for routing instance:

Routing Instance flags (DL -disable learning, SE -stats enabled,
```

AD -packet action drop, LH -mac limit hit)

| Routing<br>Instance  | Bridging<br>Domain | Index | Logical<br>System | Routing<br>flags | MAC<br>limit |
|----------------------|--------------------|-------|-------------------|------------------|--------------|
| __juniper_private1__ |                    | 1     | Default           |                  | 5000         |
| vs1                  | vlan100            | 3     | Default           |                  | 5120         |
| vs1                  | vlan200            | 4     | Default           |                  | 5120         |

## show l2-learning redundancy-groups

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show l2-learning redundancy-groups logical-system [system-name   all] &lt;redundancy-group-id [0 to 4294967294]&gt; arp-statistics nd-statistics remote-macs</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | <p>Command introduced in Junos OS Release 13.2.</p> <p>Support for logical systems added in Junos OS Release 14.1.</p> <p>Command introduced in Junos OS Release 15.1R1 for EX Series switches</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>(MX Series routers and EX9200 switches only) Display ARP statistics, Neighbor Discovery statistics, or remote MAC addresses for the Multi-Chassis Aggregated Ethernet (MC-AE) nodes for all or specified redundancy groups on a router or switch or logical systems on a router or switch. Note that the Redundancy Group ID is inherited by the bridging domain or VLAN from member AE interfaces.</p>                                                                                                                                                                                                                                                                                                                                   |
| <b>Options</b>                  | <p><b>logical-system [system-name   all]</b>—(Optional) Display information for a specified logical system or all systems.</p> <p><b>redundancy-group-id</b>—(Optional) The redundancy group identification number. The Inter-Chassis Control Protocol (ICCP) uses the redundancy group ID to associate the routing or switching devices contained in a redundancy group.</p> <p><b>arp-statistics</b>—(Optional) Count of ARP packets sent and received by the two MC-AE nodes.</p> <p><b>nd-statistics</b>—(Optional) Count of Neighbor Discovery packets sent and received by the two MC-AE nodes.</p> <p><b>remote-macs</b>—(Optional) List of remote MAC addresses in the “Installed” state, as learned from the remote MC-AE node.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Configuring Multichassis Link Aggregation on MX Series Routers</i></li> <li>• <a href="#">show interfaces mc-ae on page 1680</a></li> <li>• <i>Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation</i></li> <li>• <i>Configuring Multichassis Link Aggregation on EX Series Switches</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                            |
| <b>List of Sample Output</b>    | <p><a href="#">show l2-learning redundancy-groups arp-statistics on page 1693</a></p> <p><a href="#">show l2-learning redundancy-groups nd-statistics on page 1693</a></p> <p><a href="#">show l2-learning redundancy-groups remote-macs on page 1694</a></p> <p><a href="#">show l2-learning redundancy-groups logical-system arp-statistics (for Logical Systems) on page 1694</a></p>                                                                                                                                                                                                                                                                                                                                                     |

[show l2-learning redundancy-groups logical-system nd-statistics \(for Logical Systems\) on page 1694](#)

[show l2-learning redundancy-groups group-id on page 1694](#)

[show l2-learning redundancy-groups logical-system on page 1694](#)

**Output Fields** Output fields are listed in the approximate order in which they appear.

**Table 113: show l2-learning redundancy-groups arp-statistics Output Fields**

| Field Name                        | Field Description                                                              |
|-----------------------------------|--------------------------------------------------------------------------------|
| Redundancy Group ID               | Redundancy Group to which the following details apply.                         |
| MCLAG ARP Statistics Group ID     | ARP statistics for this Multichassis Link Aggregation Group (MC-LAG) instance. |
| ARP Rx Count From Line            | Total number of ARPs received from the Line.                                   |
| ARP Tx Count To Peer              | Total number of ARPs sent to the peer.                                         |
| ARP Rx Count From Peer            | Total number of ARPs received from the peer.                                   |
| ARP Drop Count received from line | Total number of ARPs sent by the peer that were received.                      |
| ARP Drop Count received from peer | Total number of ARPs sent by the peer that were dropped                        |
| Service-id                        | Service ID (configured at the routing instance level).                         |

**Table 114: show l2-learning redundancy-groups nd-statistics Output Fields**

| Field Name                       | Field Description                                                                             |
|----------------------------------|-----------------------------------------------------------------------------------------------|
| Redundancy Group ID              | Redundancy Group to which the following details apply.                                        |
| MCLAG ND Statistics Group ID     | Neighbor Discovery statistics for this Multichassis Link Aggregation Group (MC-LAG) instance. |
| ND Rx Count From Line            | Total number of Neighbor Discovery packets received from the Line.                            |
| ND Tx Count To Peer              | Total number of Neighbor Discovery packets sent to the peer.                                  |
| ND Rx Count From Peer            | Total number of Neighbor Discovery packets received from the peer.                            |
| ND Drop Count received from line | Total number of Neighbor Discovery packets sent by the peer that were received.               |
| ND Drop Count received from peer | Total number of Neighbor Discovery packets sent by the peer that were dropped                 |



Table 114: show l2-learning redundancy-groups nd-statistics Output Fields (*continued*)

| Field Name | Field Description                                      |
|------------|--------------------------------------------------------|
| Service-id | Service ID (configured at the routing instance level). |

Table 115: show l2-learning redundancy-groups remote-macs Output Fields

| Field Name          | Field Description                                                                                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------------|
| Redundancy Group ID | Redundancy Group to which the following details apply.                                                             |
| Peer-Addr           | IP address of the remote peer.                                                                                     |
| VLAN                | Virtual LAN identifier associated with the redundancy group.                                                       |
| MAC                 | Hardware media access control address associated with the redundancy group.                                        |
| MCAE-ID             | ID number of the MC-AE used by the redundancy group.                                                               |
| Flags               | Connection state: local connect or Remote connect. If no flag is shown, the redundancy group may not be connected. |
| Status              | Installation state: Installed or Not Installed.                                                                    |

## Sample Output

### show l2-learning redundancy-groups arp-statistics

```

user@host> show l2-learning redundancy-groups arp-statistics
Logical System : default
Redundancy Group ID : 1      Flags : Local Connect, Remote Connect

MCLAG ARP Statistics
Group ID                : 1
ARP Rx Count From Line  : 52
ARP Tx Count To Peer    : 15
ARP Rx Count From Peer  : 39
ARP Install Count       : 34
ARP Drop Count received from line : 37
ARP Drop Count received from peer  : 5

```

### show l2-learning redundancy-groups nd-statistics

```

user@host> show l2-learning redundancy-groups nd-statistics
Logical System : default
Redundancy Group ID : 1      Flags : Local Connect, Remote Connect

MCLAG ND Statistics
Group ID                : 1
ND Rx Count From Line   : 52
ND Tx Count To Peer     : 15
ND Rx Count From Peer   : 39
ND Install Count        : 34
ND Drop Count received from line : 37
ND Drop Count received from peer  : 5

```

### show l2-learning redundancy-groups remote-macs

```
user@host> show l2-learning redundancy-groups <redundancy-group-id> remote-macs
Redundancy Group ID : 1      Flags : Local Connect, Remote Connect

Service-id Peer-Addr  VLAN      MAC              MCAE-ID Subunit Opcode
Flags      Status
10         1.1.1.2     100      64:87:88:6a:df:f0  1        0       1
0          Installed
```

### show l2-learning redundancy-groups logical-system arp-statistics (for Logical Systems)

```
user@host> show l2-learning redundancy-groups logical-system LS1 arp-statistics

Redundancy Group ID : 1      Flags : Local Connect, Remote Connect

MCLAG ARP Statistics
Group ID              : 1
ARP Rx Count From Line : 52
ARP Tx Count To Peer   : 15
ARP Rx Count From Peer : 39
ARP Install Count      : 34
ARP Drop Count received from line : 37
ARP Drop Count received from peer : 5
```

### show l2-learning redundancy-groups logical-system nd-statistics (for Logical Systems)

```
user@host> show l2-learning redundancy-groups logical-system LS1 nd-statistics

Redundancy Group ID : 1      Flags : Local Connect, Remote Connect

MCLAG ND Statistics
Group ID              : 1
ND Rx Count From Line : 52
ND Tx Count To Peer   : 15
ND Rx Count From Peer : 39
ND Install Count      : 34
ND Drop Count received from line : 37
ND Drop Count received from peer : 5
```

### show l2-learning redundancy-groups group-id

```
user@host> show l2-learning redundancy-groups 1

Redundancy Group ID : 1      Flags : Local Connect, Remote Connect
```

### show l2-learning redundancy-groups logical-system

```
user@host> show l2-learning redundancy-groups logical-system ls1

Redundancy Group ID : 2      Flags : Local Connect, Remote Connect
```

## show lacp interfaces

**Syntax** `show lacp interfaces`  
`<interface-name>`

**Release Information** Command introduced in Junos OS Release 7.6.

**Description** Display Link Aggregation Control Protocol (LACP) information about the specified aggregated Ethernet, Fast Ethernet, or Gigabit Ethernet interface.

**Options** **none**—Display LACP information for all interfaces.

**interface-name**—(Optional) Display LACP information for the specified interface:

- Aggregated Ethernet—**aenumber**
- Fast Ethernet—**fe-fpc/pic/port**
- Gigabit Ethernet—**ge-fpc/pic/port**



**NOTE:** The `show lacp interfaces` command returns the following error message if your system is not configured in either active or passive LACP mode:

“Warning: lacp subsystem not running – not needed by configuration”

**Required Privilege Level** view

**List of Sample Output** [show lacp interfaces \(Aggregated Ethernet\) on page 1698](#)  
[show lacp interfaces \(Gigabit Ethernet\) on page 1698](#)

**Output Fields** [Table 87 on page 1498](#) lists the output fields for the `show lacp interfaces` command. Output fields are listed in the approximate order in which they appear.

**Table 116: show lacp interfaces Output Fields**

| Field Name           | Field Description           |
|----------------------|-----------------------------|
| Aggregated interface | Aggregated interface value. |

Table 116: show lacp interfaces Output Fields (*continued*)

| Field Name | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LACP State | <p>LACP state information for each aggregated interface:</p> <ul style="list-style-type: none"> <li>• <b>Role</b>—Role played by the interface. It can be one of the following: <ul style="list-style-type: none"> <li>• <b>Actor</b>—Local device participating in LACP negotiation.</li> <li>• <b>Partner</b>—Remote device participating in LACP negotiation.</li> </ul> </li> <li>• <b>Exp</b>—Expired state. <b>Yes</b> indicates the actor or partner is in an expired state. <b>No</b> indicates the actor or partner is not in an expired state.</li> <li>• <b>Def</b>—Default. <b>Yes</b> indicates that the actor's receive machine is using the default operational partner information, administratively configured for the partner. <b>No</b> indicates the operational partner information in use has been received in an LACP PDU.</li> <li>• <b>Dist</b>—Distribution of outgoing frames. <b>No</b> indicates distribution of outgoing frames on the link is currently disabled and is not expected to be enabled. Otherwise, the value is <b>Yes</b>.</li> <li>• <b>Col</b>—Collection of incoming frames. <b>Yes</b> indicates collection of incoming frames on the link is currently enabled and is not expected to be disabled. Otherwise, the value is <b>No</b>.</li> <li>• <b>Syn</b>—Synchronization. If the value is <b>Yes</b>, the link is considered synchronized. It has been allocated to the correct link aggregation group, the group has been associated with a compatible aggregator, and the identity of the link aggregation group is consistent with the system ID and operational key information transmitted. If the value is <b>No</b>, the link is not synchronized. It is currently not in the right aggregation.</li> <li>• <b>Aggr</b>—Ability of aggregation port to aggregate (<b>Yes</b>) or to operate only as an individual link (<b>No</b>).</li> <li>• <b>Timeout</b>—LACP timeout preference. Periodic transmissions of LACP PDUs occur at either a slow or fast transmission rate, depending upon the expressed LACP timeout preference (<b>Long Timeout</b> or <b>Short Timeout</b>).</li> <li>• <b>Activity</b>—Actor or partner's port activity. <b>Passive</b> indicates the port's preference for not transmitting LAC PDUs unless its partner's control value is <b>Active</b>. <b>Active</b> indicates the port's preference to participate in the protocol regardless of the partner's control value.</li> </ul> |

Table 116: show lacp interfaces Output Fields (*continued*)

| Field Name      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LACP Protocol   | <p>LACP protocol information for each aggregated interface:</p> <ul style="list-style-type: none"> <li>Link state (active or standby) indicated in parentheses next to the interface when link protection is configured.</li> <li><b>Receive State</b>—One of the following values: <ul style="list-style-type: none"> <li><b>Current</b>—The state machine receives an LACP PDU and enters the <b>Current</b> state.</li> <li><b>Defaulted</b>—If no LACP PDU is received before the timer for the <b>Current</b> state expires a second time, the state machine enters the <b>Defaulted</b> state.</li> <li><b>Expired</b>—If no LACP PDU is received before the timer for the <b>Current</b> state expires once, the state machine enters the <b>Expired</b> state.</li> <li><b>Initialize</b>—When the physical connectivity of a link changes or a Begin event occurs, the state machine enters the <b>Initialize</b> state.</li> <li><b>LACP Disabled</b>—If the port is operating in half duplex, the operation of LACP is disabled on the port, forcing the state to <b>LACP Disabled</b>. This state is similar to the <b>Defaulted</b> state, except that the port is forced to operate as an individual port.</li> <li><b>Port Disabled</b>—If the port becomes inoperable and a Begin event has not occurred, the state machine enters the <b>Port Disabled</b> state.</li> </ul> </li> <li><b>Transmit State</b>—Transmit state of state machine. One of the following values: <ul style="list-style-type: none"> <li><b>Fast Periodic</b>—Periodic transmissions are enabled at a fast transmission rate.</li> <li><b>No Periodic</b>—Periodic transmissions are disabled.</li> <li><b>Periodic Timer</b>—Transitory state entered when the periodic timer expires.</li> <li><b>Slow Periodic</b>—Periodic transmissions are enabled at a slow transmission rate.</li> </ul> </li> <li><b>Mux State</b>—State of the multiplexer state machine for the aggregation port. The state is one of the following values: <ul style="list-style-type: none"> <li><b>Attached</b>—Multiplexer state machine initiates the process of attaching the port to the selected aggregator.</li> <li><b>Collecting—Yes</b> indicates that the receive function of this link is enabled with respect to its participation in an aggregation. Received frames are passed to the aggregator for collection. <b>No</b> indicates the receive function of this link is not enabled.</li> <li><b>Collecting Distributing</b>—Collecting and distributing states are merged together to form a combined state (coupled control). Because independent control is not possible, the coupled control state machine does not wait for the partner to signal that collection has started before enabling both collection and distribution.</li> <li><b>Detached</b>—Process of detaching the port from the aggregator is in progress.</li> <li><b>Distributing—Yes</b> indicates that the transmit function of this link is enabled with respect to its participation in an aggregation. Frames may be passed down from the aggregator's distribution function for transmission. <b>No</b> indicates the transmit function of this link is not enabled.</li> <li><b>Waiting</b>—Multiplexer state machine is in a holding process, awaiting an outcome.</li> </ul> </li> </ul> |
| LACP Statistics | <p>LACP statistics are returned when the <b>extensive</b> option is used and provides the following information:</p> <ul style="list-style-type: none"> <li><b>LACP Rx</b>—LACP received counter that increments for each normal hello.</li> <li><b>LACP Tx</b>—Number of LACP packets transmitted.</li> <li><b>Unknown Rx</b>—Number of unrecognized packet errors logged.</li> <li><b>Illegal Rx</b>—Number of invalid packets received.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## Sample Output

### show lacp interfaces (Aggregated Ethernet)

```

user@host> show lacp interfaces ae0 extensive
Aggregated interface: ae0
LACP state:      Role  Exp  Def  Dist  Col  Syn  Aggr  Timeout  Activity
ge-1/0/1        Actor  No   Yes  No   No   No   Yes    Fast    Active
ge-1/0/1        Partner No   Yes  No   No   No   Yes    Fast    Passive
ge-1/0/2        Actor  No   Yes  No   No   No   Yes    Fast    Active
ge-1/0/2        Partner No   Yes  No   No   No   Yes    Fast    Passive

LACP protocol:      Receive State      Transmit State      Mux State
ge-1/0/1            CURRENT          Fast periodic      Collecting
distributing
ge-1/0/2            CURRENT          Fast periodic      Collecting
distributing
ge-1/0/1 (active)    CURRENT          Fast periodic      Collecting
distributing
ge-1/0/2 (standby)   CURRENT          Fast periodic      WAITING
LACP Statistics:      LACP Rx      LACP Tx      Unknown Rx      Illegal Rx
ge-1/0/1              0             0             0             0
ge-1/0/2              0             0             0             0

```

### show lacp interfaces (Gigabit Ethernet)

```

user@host> show lacp interfaces ge-0/3/0
Aggregated interface: ae0
LACP State:      Role  Exp  Def  Dist  Col  Syn  Aggr  Timeout  Activity
ge-0/3/0        Actor  No   No   Yes  Yes  Yes  Yes    Fast    Active
ge-0/3/0        Partner No   No   Yes  Yes  Yes  Yes    Fast    Active
LACP Protocol:      Receive State      Transmit State      Mux State
ge-0/3/0            Current          Fast periodic      Collecting distributing

```

## show lldp

|                                 |                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show lldp</code><br><code>&lt;detail&gt;</code>                                                                                                                        |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.                                                                                                                                  |
| <b>Description</b>              | Display information about the Link Layer Discovery Protocol (LLDP).                                                                                                          |
| <b>Options</b>                  | <b>detail</b> —(Optional) Display the detailed output level.                                                                                                                 |
| <b>Required Privilege Level</b> | view                                                                                                                                                                         |
| <b>List of Sample Output</b>    | <a href="#">show lldp on page 1701</a><br><a href="#">show lldp detail on page 1701</a>                                                                                      |
| <b>Output Fields</b>            | <a href="#">Table 117 on page 1699</a> describes the output fields for the <b>show lldp</b> command. Output fields are listed in the approximate order in which they appear. |

**Table 117: show lldp Output Fields**

| Field Name             | Field Description                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LLDP                   | Status of LLDP: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                                                                                                                                                                               |
| Advertisement interval | Value of the advertisement interval parameter.                                                                                                                                                                                                                                                                                                                                                    |
| Transmit delay         | Value of the transmit delay parameter.                                                                                                                                                                                                                                                                                                                                                            |
| Hold timer             | Value of the hold timer parameter.                                                                                                                                                                                                                                                                                                                                                                |
| Notification interval  | Value of the notification interval parameter.                                                                                                                                                                                                                                                                                                                                                     |
| Config Trap Interval   | Value of the configuration trap parameter.                                                                                                                                                                                                                                                                                                                                                        |
| Connection Hold timer  | Value of the connection hold timer parameter.                                                                                                                                                                                                                                                                                                                                                     |
| Port ID TLV subtype    | <ul style="list-style-type: none"> <li><i>interface-name</i>—Indicates the interface name as the port information for the local device.</li> <li><b>locally-assigned</b>—Indicates that the sub-type for port ID TLV generation is locally assigned value of SNMP index of the interface.</li> </ul> <p>For more information about port ID TLV subtype, see <a href="#">port-id-subtype..</a></p> |

Table 117: show lldp Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port Description TLV type | <p>Following value used for port description TLV:</p> <ul style="list-style-type: none"> <li><b>interface-alias (ifAlias)</b>—Indicates that the <i>ifAlias</i> MIB object value is used to generate the port description TLV.</li> <li><b>interface-description (ifDescr)</b>—Indicates that the <i>ifDescr</i> MIB object value is used to generate the port description TLV.</li> </ul> <p>For more information about port description TLV type, see <a href="#">port-description-type</a>.</p> |
| Interface                 | <p>Name of the interface for which LLDP configuration information is being reported</p> <p>For information about interface names, see <i>Interface Naming Overview</i>. For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i>. For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i>.</p>                                                                       |
| Parent Interface          | Name of the aggregated Ethernet interface, if any, to which the interface belongs.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| LLDP                      | LLDP operating state. The state can be Enabled or Disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| LLDP-MED                  | LLDP-MED operating state. The state can be Enabled or Disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Power Negotiation         | LLDP power negotiation operating state. The state can be Enabled or Disabled.                                                                                                                                                                                                                                                                                                                                                                                                                      |
| LLDP basic TLVs supported | List of basic LLDP TLVs supported by this device ( <b>detail</b> only).                                                                                                                                                                                                                                                                                                                                                                                                                            |
| LLDP 802 TLVs supported   | List of IEEE 802.1 LLDP TLVs supported by this device ( <b>detail</b> only).                                                                                                                                                                                                                                                                                                                                                                                                                       |



## Sample Output

### show lldp

```
user@host> show lldp
LLDP : Enabled
Advertisement interval : 30 seconds
Transmit delay : 2 seconds
Hold timer : 120 seconds
Notification interval : 0 Second(s)
Config Trap Interval : 0 seconds
Connection Hold timer : 300 seconds
Port ID TLV subtype : locally-assigned
Port Description TLV type : interface-description (ifDescr)
```

| Interface | Parent Interface | LLDP    | LLDP-MED | Power Negotiation |
|-----------|------------------|---------|----------|-------------------|
| all       | -                | Enabled |          |                   |

## Sample Output

### show lldp detail

```
user@host> show lldp detail
LLDP : Enabled
Advertisement interval : 30 seconds
Transmit delay : 2 seconds
Hold timer : 120 seconds
Notification interval : 0 Second(s)
Config Trap Interval : 0 seconds
Connection Hold timer : 300 seconds
Port ID TLV subtype : locally-assigned
Port Description TLV type : interface-description (ifDescr)
```

| Interface      | Parent Interface | LLDP    | LLDP-MED | Power Negotiation |
|----------------|------------------|---------|----------|-------------------|
| Neighbor count |                  |         |          |                   |
| all            | -                | Enabled |          |                   |
| 2              |                  |         |          |                   |

| Interface | Parent Interface | Vlan-id | Vlan-name |
|-----------|------------------|---------|-----------|
| xe-0/0/0  | -                | 4080    | vlan-4080 |
| xe-0/0/1  | -                | 4080    | vlan-4080 |

Basic Management TLVs supported:  
End Of LLDPDU, Chassis ID, Port ID, Time To Live, Port Description, System Name,  
System Description, System Capabilities, Management Address

Organizationally Specific TLVs supported:  
Port VLAN tag, VLAN Name, MAC/PHY Configuration/Status, Link Aggregation, Maximum  
Frame Size

## show lldp local-information

|                                 |                                                                                                                                                                                                                      |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show lldp local-information                                                                                                                                                                                          |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.                                                                                                                                                                          |
| <b>Description</b>              | Display local Link Layer Discovery Protocol (LLDP) information.                                                                                                                                                      |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                         |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                 |
| <b>List of Sample Output</b>    | <a href="#">show lldp local-information(Management Information Address Subtype is IPv4) on page 1704</a><br><a href="#">show lldp local-information(Management Information Address Subtype is IPv6) on page 1704</a> |
| <b>Output Fields</b>            | <a href="#">Table 118 on page 1702</a> describes the output fields for the <b>show lldp local-information</b> command. Output fields are listed in the approximate order in which they appear.                       |

**Table 118: show lldp local-information Output Fields**

| Field Name                            | Field Description                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LLDP Local Information details</b> | Information that follows pertains to the local system.                                                                                                                                                                                                                                                                                                            |
| <b>Chassis ID</b>                     | List of chassis identifiers for local information.                                                                                                                                                                                                                                                                                                                |
| <b>System name</b>                    | Local system name reported by LLDP.                                                                                                                                                                                                                                                                                                                               |
| <b>System descr</b>                   | Local system description reported by LLDP.                                                                                                                                                                                                                                                                                                                        |
| <b>System Capabilities</b>            | Capabilities (such as <b>Bridge</b> or <b>Router</b> ) that are <b>Supported</b> or <b>Enabled</b> by system on the interface.                                                                                                                                                                                                                                    |
| <b>Management Information</b>         | Listed by <b>Interface Name</b> , <b>Address Subtype</b> (such as <b>ipv4</b> , <b>ipv6</b> ), <b>Address</b> (such as <b>192.168.168.229</b> , <b>1fd::1a10</b> ), <b>Interface Number</b> , and <b>Interface Numbering Subtype</b> .                                                                                                                            |
| <b>Interface Name</b>                 | List of local interfaces.<br><br>For information about interface names, see <i>Interface Naming Overview</i> . For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i> . For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i> . |
| <b>Parent Interface</b>               | Name of the <b>ae</b> interface to which the interface belongs                                                                                                                                                                                                                                                                                                    |
| <b>Interface ID</b>                   | List of local interface identifiers.                                                                                                                                                                                                                                                                                                                              |

Table 118: show lldp local-information Output Fields (*continued*)

| Field Name                   | Field Description                                        |
|------------------------------|----------------------------------------------------------|
| <b>Interface Description</b> | List of local interface descriptions.                    |
| <b>Status</b>                | List of interface conditions: <b>UP</b> or <b>DOWN</b> . |

## Sample Output

### show lldp local-information(Management Information Address Subtype is IPv4)

```

user@host> show lldp local-information
LLDP Local Information details

Chassis ID   : 64:87:88:65:37:c0
System name  : apg-hp1
System descr : Juniper Networks, Inc. mx240 , version 14.1I20131231_0701_builder
               [builder] Build date: 2013-12-31 07:13:42 UTC

System Capabilities
  Supported      : Bridge Router
  Enabled        : Bridge Router

Management Information
  Interface Name : Unknown
  Address Subtype : IPv4(1)
  Address        : 10.216.97.103
  Interface Number : 1
  Interface Numbering Subtype : ifIndex(2)

Interface name  Parent Interface  Interface ID  Interface description  Status
fxp0            -                1             fxp0                   Up
me0             -                33            me0                     Up
ge-2/0/0        ae0             1475          ge-2/0/0               Up
ge-2/0/1        ae0             1476          ge-2/0/1               Up

```

### show lldp local-information(Management Information Address Subtype is IPv6)

```

user@host> show lldp local-information
LLDP Local Information details

Chassis ID   : ac:4b:c8:92:67:c0
System name  : apg-hp
System descr : Juniper Networks, Inc. mx240 , version 13.2-20131210.0 [builder]
               Build date: 2013-12-10 06:23:15 UTC

System Capabilities
  Supported      : Bridge Router
  Enabled        : Bridge Router

Management Information
  Interface Name : fxp0
  Address Subtype : IPv6(2)
  Address        : 1fd::1a20
  Interface Number : 1
  Interface Numbering Subtype : ifIndex(2)

Interface name  Parent Interface  Interface ID  Interface description  Status
ge-1/2/4        -                530           -                       Down
ge-1/2/5        -                531           -                       Down
ge-1/2/2        -                528           ge-1/2/2               Up
ge-1/2/3        -                529           ge-1/2/3               Up

```

## show lldp neighbors

**Syntax** `show lldp neighbors`  
`<interface interface-name>`

**Release Information** Command introduced in Junos OS Release 9.6.

**Description** Display information about LLDP neighbors.

For information about interface names, see *Interface Naming Overview*. For information about interface names for TX Matrix routers, see *TX Matrix Router Chassis and Interface Names*. For information about FPC numbering on TX Matrix routers, see *Routing Matrix with a TX Matrix Router FPC Numbering*.

For information about extended port names in the Junos Fusion technology, see *Understanding Junos Fusion Ports*.

**Options** `interface interface-name`—(Optional) Display the neighbor information about a particular physical interface.



**NOTE:** Starting with Junos OS Release 14.2, you can also display LLDP neighbor details for management interfaces, such as `fxp` or `me`, on MX Series routers.

**Required Privilege Level** view

**Related Documentation**

- [clear lldp neighbors on page 1269](#)

**List of Sample Output** [show lldp neighbors on page 1708](#)  
[show lldp neighbors interface ge-0/0/4 \(Management Address is IPv4\) on page 1708](#)  
[show lldp neighbors interface ge-0/0/4 \(Management Address is IPv6\) on page 1709](#)  
[show lldp neighbors \(Management Ethernet Interfaces\) on page 1710](#)

**Output Fields** [Table 119 on page 1705](#) describes the output fields for the `show lldp neighbors` command. Output fields are listed in the approximate order in which they appear.

**Table 119: show lldp neighbors Output Fields**

| Field Name                      | Field Description                                                     |
|---------------------------------|-----------------------------------------------------------------------|
| LLDP Remote Devices Information | Information about remote devices.                                     |
| LocalInterface                  | List of local interfaces for which neighbor information is available. |
| ChassisId                       | List of chassis identifiers for neighbors.                            |

Table 119: show lldp neighbors Output Fields (*continued*)

| Field Name                       | Field Description                                                                                                      |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>PortInfo</b>                  | List of port information gathered from neighbors. This could be the port identifier or port description.               |
| <b>SysName</b>                   | List of system names gathered from neighbors.                                                                          |
| <b>LLDP Neighbor Information</b> | Information about both local and neighbor systems on the interface (appears when the <b>interface</b> option is used). |
| <b>Local Information</b>         | Information about local systems on the interface (appears when the <b>interface</b> option is used).                   |
| <b>Neighbor Information</b>      | Information about both local and neighbor system on the interface (appears when the <b>interface</b> option is used).  |
| <b>Index</b>                     | Local interface index (appears when the <b>interface</b> option is used).                                              |
| <b>Time Mark</b>                 | Date and timestamp of information (appears when the <b>interface</b> option is used).                                  |
| <b>Time To Live</b>              | Number of seconds for which this information is valid (appears when the <b>interface</b> option is used).              |
| <b>Local Interface</b>           | Name of the local physical interface (appears when the <b>interface</b> option is used).                               |
| <b>Parent Interface</b>          | Name of the <b>ae</b> interface to which the interface belongs                                                         |
| <b>Local Port ID</b>             | Local port identifier (appears when the interface option is used).                                                     |
| <b>Neighbor Information</b>      | Information about neighbor systems on the interface (appears when the <b>interface</b> option is used).                |
| <b>Chassis type</b>              | Type of chassis identifier supplied, such as <b>MAC address</b> (appears when the <b>interface</b> option is used).    |
| <b>Chassis ID</b>                | Chassis identifier of type listed (appears when the <b>interface</b> option is used).                                  |
| <b>Port type</b>                 | Type of port identifier supplied, such as <b>local</b> (appears when the <b>interface</b> option is used).             |
| <b>Port ID</b>                   | Port identifier of type listed (appears when the <b>interface</b> option is used).                                     |
| <b>Port description</b>          | Port description (appears when the <b>interface</b> option is used).                                                   |
| <b>System name</b>               | Name supplied by the system on the interface (appears when the <b>interface</b> option is used).                       |
| <b>System Description</b>        | Description supplied by the system on the interface (appears when the <b>interface</b> option is used).                |

Table 119: show lldp neighbors Output Fields (*continued*)

| Field Name                 | Field Description                                                                                                                                                                                                                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>System Capabilities</b> | Capabilities (such as <b>bridge</b> or <b>router</b> ) that are <b>Supported</b> or <b>Enabled</b> by the system on the interface (appears when the <b>interface</b> option is used).                                                                                                                              |
| <b>Management address</b>  | Details of the management address: <b>Address Type</b> (such as <b>ipv4</b> and <b>ipv6</b> ), <b>Address</b> (such as <b>10.204.34.35</b> , <b>1fd::1a10</b> ), <b>Interface Number</b> , <b>Interface Subtype</b> , and <b>Organization Identifier (OID)</b> (appears when the <b>interface</b> option is used). |
| <b>Organization Info</b>   | One or more entries listing remote information by Organizationally Unique Identifier ( <b>OUI</b> ), <b>Subtype</b> , <b>Index</b> , and <b>Info</b> (appears when the <b>interface</b> option is used).                                                                                                           |

## Sample Output

### show lldp neighbors

```
user@host> show lldp neighbors
```

| Local Interface | Parent Interface | Chassis Id        | Port info | System Name |
|-----------------|------------------|-------------------|-----------|-------------|
| ge-2/0/0        | ae0              | ac:4b:c8:92:67:c0 | 528       | apg-hp      |
| ge-2/0/1        | ae0              | ac:4b:c8:92:67:c0 | 529       | apg-hp      |

## Sample Output

### show lldp neighbors interface ge-0/0/4 (Management Address is IPv4)

```
user@host> show lldp neighbors interface ge-0/0/4
```

```
LLDP Neighbor Information:
```

```
Local Information:
```

```
Index: 2 Time to live: 120 Time mark: Tue Dec 31 11:47:46 2013 Age: 15 secs
```

```
Local Interface      : ge-2/0/1
```

```
Parent Interface     : ae0
```

```
Local Port ID        : 1476
```

```
Ageout Count         : 0
```

```
Neighbour Information:
```

```
Chassis type         : Mac address
```

```
Chassis ID           : ac:4b:c8:92:67:c0
```

```
Port type            : Locally assigned
```

```
Port ID              : 529
```

```
Port description     : ge-1/2/3
```

```
System name          : apg-hp
```

```
System Description   : Juniper Networks, Inc. mx240 , version 14.1-20131222.0
```

```
[builder] Build date: 2013-12-22 09:13:26 UTC
```

```
System capabilities
```

```
Supported: Bridge Router
```

```
Enabled   : Bridge Router
```

```
Management address
```

```
Address Type         : IPv4(1)
```

```
Address              : 10.216.98.57
```

```
Interface Number     : 1
```

```
Interface Subtype    : ifIndex(2)
```

```
OID                  : 1.3.6.1.2.1.31.1.1.1.1.1.
```

```
Organization Info
```

```
OUI                  : IEEE 802.3 Private (0x00120f)
```

```
Subtype              : MAC/PHY Configuration/Status (1)
```

```
Info                 : Autonegotiation [supported, enabled (0x3)], PMD Autonegotiation
```

```
Capability (0x1d), MAU Type (0x0)
```

```
Index                : 1
```

```
Organization Info
```

```
OUI                  : IEEE 802.3 Private (0x00120f)
```

```
Subtype              : Link Aggregation (3)
```

```
Info                 : Aggregation Status (0x3), Aggregation Port ID (1694498816)
```

```
Index                : 2
```

```
Organization Info
```

```
OUI                  : IEEE 802.3 Private (0x00120f)
```



```

Subtype : Maximum Frame Size (4)
Info    : MTU Size (1518)
Index   : 3

```

### show lldp neighbors interface ge-0/0/4 (Management Address is IPv6)

```

user@host> show lldp neighbors interface ge-0/0/4
LLDP Neighbor Information:
Local Information:
Index: 1 Time to live: 120 Time mark: Thu Dec 12 07:19:45 2013 Age: 28 secs
Local Interface   : ge-1/2/2
Parent Interface  : -
Local Port ID     : 528
Ageout Count      : 0

Neighbour Information:
Chassis type      : Mac address
Chassis ID        : 64:87:88:65:37:c0
Port type         : Locally assigned
Port ID           : 1475
Port description  : ge-2/0/0
System name       : apg-hp1

System Description : Juniper Networks, Inc. mx240 , version 11.4R10 Build date:
2013-10-24 10:10:02 UTC

System capabilities
Supported: Bridge Router
Enabled  : Bridge Router

Management address
Address Type      : IPv6(2)
Address           : 1fd::1a10
Interface Number  : 1
Interface Subtype : ifIndex(2)
OID               : 1.3.6.1.2.1.31.1.1.1.1.1.

Organization Info
OUI               : IEEE 802.3 Private (0x00120f)
Subtype           : MAC/PHY Configuration/Status (1)
Info              : Autonegotiation [supported, enabled (0x3)], PMD Autonegotiation
Capability (0x5), MAU Type (0x0)
Index             : 1

Organization Info
OUI               : IEEE 802.3 Private (0x00120f)
Subtype           : Link Aggregation (3)
Info              : Aggregation Status (0x1), Aggregation Port ID (0)
Index             : 2

Organization Info
OUI               : IEEE 802.3 Private (0x00120f)
Subtype           : Maximum Frame Size (4)
Info              : MTU Size (1518)
Index             : 3

Organization Info
OUI               : Ethernet Bridged (0x0080c2)
Subtype           : VLAN Name (3)

```

Info : VLAN ID (100), VLAN Name (vlan-100)  
Index : 4

#### show lldp neighbors (Management Ethernet Interfaces)

user@host> show lldp neighbors

| Local Interface<br>System Name | Parent Interface | Chassis Id        | Port info |
|--------------------------------|------------------|-------------------|-----------|
| fxp0<br>x2-sw35                | -                | 78:fe:3d:ee:4e:00 | 151       |
| xe-0/0/0<br>sitara             | -                | a8:d0:e5:50:26:c0 | 512       |
| xe-0/0/1<br>sitara             | -                | a8:d0:e5:50:26:c0 | 513       |

## show lldp remote-global-statistics

|                                 |                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show lldp remote-global-statistics                                                                                                                                                                    |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.6.                                                                                                                                                           |
| <b>Description</b>              | Display remote Link Layer Discovery Protocol (LLDP) global statistics.                                                                                                                                |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                          |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                  |
| <b>List of Sample Output</b>    | <a href="#">show lldp remote-global-statistics on page 1712</a>                                                                                                                                       |
| <b>Output Fields</b>            | <a href="#">Table 120 on page 1711</a> describes the output fields for the <b>show lldp remote-global-statistics</b> command. Output fields are listed in the approximate order in which they appear. |

**Table 120: show lldp remote-global-statistics Output Fields**

| Field Name                          | Field Description                                                                                     |
|-------------------------------------|-------------------------------------------------------------------------------------------------------|
| LLDP Remote Database Table Counters | Information about remote database table counters.                                                     |
| LastchangeTime                      | Time elapsed between LLDP agent startup and the last change to the remote database table information. |
| Inserts                             | Number of insertions made in the remote database table.                                               |
| Deletes                             | Number of deletions made in the remote database table.                                                |
| Drops                               | Number of LLDP frames dropped from the remote database table because of errors.                       |
| Ageouts                             | Number of remote database table entries that have aged out of the table.                              |

## Sample Output

### show lldp remote-global-statistics

```
user@host> show lldp remote-global-statistics
user@host> show lldp remote-global-statistics
LLDP Remote Database Table Counters
LastchangeTime      Inserts    Deletes    Drops    Ageouts
00:00:76 (76 sec)   192        0          0        0
```

## show lldp statistics

**Syntax** `show lldp statistics`  
`<interface interface-name>`

**Release Information** Command introduced in Junos OS Release 9.6.

**Description** Display information about Link Layer Discovery Protocol (LLDP) statistics.

**Options** `interface interface-name`—(Optional) Display the statistics about a particular physical interface.



**NOTE:** Starting with Junos OS Release 14.2, you can also display LLDP statistical details for management interfaces, such as `fxp` or `me`, on MX Series routers.

**Required Privilege Level** view

**Related Documentation** • [clear lldp statistics on page 1270](#)

**List of Sample Output** [show lldp statistics on page 1715](#)  
[show lldp statistics interface ge-0/1/1 on page 1715](#)

**Output Fields** [Table 121 on page 1713](#) describes the output fields for the **show lldp statistics** command. Output fields are listed in the approximate order in which they appear.

**Table 121: show lldp statistics Output Fields**

| Field Name          | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Interface</b>    | Interface name.<br><br>For information about interface names, see <i>Interface Naming Overview</i> . For information about interface names for TX Matrix routers, see <i>TX Matrix Router Chassis and Interface Names</i> . For information about FPC numbering on TX Matrix routers, see <i>Routing Matrix with a TX Matrix Router FPC Numbering</i> .<br><br>For information about extended port names in the Junos Fusion technology, see <i>Understanding Junos Fusion Ports</i> . |
| <b>Received</b>     | Number of LLDP frames received on this interface.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Transmitted</b>  | Number of LLDP frames sent on this interface.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Unknown-TLVs</b> | Number of LLDP frames with unsupported content received on this interface.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>With-Errors</b>  | Number of LLDP frames with errors received on this interface.                                                                                                                                                                                                                                                                                                                                                                                                                          |

Table 121: show lldp statistics Output Fields (*continued*)

| Field Name           | Field Description                                                                         |
|----------------------|-------------------------------------------------------------------------------------------|
| <b>Discarded</b>     | Number of LLDP frames received on this interface that were discarded because of problems. |
| <b>Transmitted</b>   | Total number of LLDP frames that were transmitted on an interface.                        |
| <b>Untransmitted</b> | Total number of LLDP frames that were untransmitted on an interface.                      |

## Sample Output

### show lldp statistics

```
user@host> show lldp statistics
```

| Interface  | Parent Interface | Received | Unknown TLVs | With Errors |
|------------|------------------|----------|--------------|-------------|
| xe-3/0/0.0 | ae31.0           | 1564     | 0            | 0           |
| xe-3/0/1.0 | ae31.0           | 1564     | 0            | 0           |
| xe-3/0/2.0 | ae31.0           | 1565     | 0            | 0           |
| xe-3/0/3.0 | ae31.0           | 1566     | 0            | 0           |
| xe-3/0/4.0 | ae31.0           | 1598     | 0            | 0           |
| xe-3/0/5.0 | ae31.0           | 1598     | 0            | 0           |
| xe-3/0/6.0 | ae31.0           | 1596     | 0            | 0           |
| xe-3/0/7.0 | ae31.0           | 1597     | 0            | 0           |
| xe-5/0/6.0 | -                | 0        | 0            | 0           |
| xe-5/0/7.0 | -                | 0        | 0            | 0           |

| Discarded TLVs | Transmitted | Untransmitted |
|----------------|-------------|---------------|
| 0              | 3044        | 1             |
| 0              | 3044        | 1             |
| 0              | 3044        | 1             |
| 0              | 3044        | 1             |
| 0              | 3075        | 1             |
| 0              | 3075        | 1             |
| 0              | 3075        | 1             |
| 0              | 3075        | 1             |
| 0              | 17312       | 0             |
| 0              | 17312       | 0             |

## Sample Output

### show lldp statistics interface ge-0/1/1

```
user@host> show lldp statistics interface ge-0/1/1
```

| Interface | Received | Transmitted | Unknown-TLVs | With-Errors | Discarded |
|-----------|----------|-------------|--------------|-------------|-----------|
| ge-0/1/1  | 544      | 540         | 0            | 0           | 0         |

## show oam ethernet connectivity-fault-management delay-statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show oam ethernet connectivity-fault-management delay-statistics &lt;count <i>entry-count</i>&gt; &lt;local-mep <i>mep-id</i>&gt; &lt;maintenance-association <i>ma-name</i>&gt; &lt;maintenance-domain <i>md-name</i>&gt; &lt;remote-mep <i>remote-mep-id</i>&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | <p>Command introduced in Junos OS Release 9.5.</p> <p>Command introduced in Junos OS Release 11.4 for EX Series switches.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | <p>On MX Series routers with Ethernet interfaces on Dense Port Concentrators (DPCs), display ETH-DM delay statistics.</p> <p>On EX Series switches, display delay measurement results.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b>count <i>entry-count</i></b>—(Optional) Number of entries to display from the statistics table. The range of values is 1 through 100. The default value is 100 entries.</p> <p><b>local-mep <i>mep-id</i></b>—(Optional) Numeric identifier of the local MEP. On MX Series routers, the range of values is 1 through 8192. On EX Series switches, the range of values is 1 through 8191.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association.</p> <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing connectivity fault management (CFM) maintenance domain.</p> <p><b>remote-mep <i>remote-mep-id</i></b>—(Optional) Numeric identifier of the remote MEP. On MX Series routers, the range of values is 1 through 8192. On EX Series switches, the range of values is 1 through 8191.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a></li> <li>• <a href="#">clear oam ethernet connectivity-fault-management delay-statistics</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management interfaces on page 1724</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-database on page 1742</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li> </ul>                                                                                                                                                                                                                                                                                                       |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management delay-statistics on page 1718</a></p> <p><a href="#">show oam ethernet connectivity-fault-management delay-statistics remote-mep on page 1718</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Output Fields</b>            | <p>Table 122 on page 1717 lists the output fields for the <b>show oam ethernet connectivity-fault-management delay-statistics</b> command and the <b>show oam ethernet</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



**connectivity-fault-management mep-statistics** command. Output fields are listed in the approximate order in which they appear.

**Table 122: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields**

| Output Field Name               | Field Description                                                                                                                                                                                                                                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEP identifier                  | Maintenance association end point (MEP) numeric identifier.                                                                                                                                                                                                                                                              |
| MAC address                     | Unicast MAC address configured for the MEP.                                                                                                                                                                                                                                                                              |
| Remote MEP count                | Number of remote MEPs (unless you specify the <b>remote-mep</b> option).                                                                                                                                                                                                                                                 |
| Remote MEP identifier           | Numeric identifier of the remote MEP.                                                                                                                                                                                                                                                                                    |
| Remote MAC address              | Unicast MAC address of the remote MEP.                                                                                                                                                                                                                                                                                   |
| Index                           | Index number that corresponds to the ETH-DM entry in the CFM database.                                                                                                                                                                                                                                                   |
| One-way delay (usec)            | <p>For a one-way ETH-DM session, the frame delay time, in microseconds, measured at the receiver MEP.</p> <p>For a detailed description of one-way Ethernet frame delay measurement, see the <i>ITU-T Y.1731 Ethernet Service OAM</i> topics in the <i>Junos OS Network Interfaces Library for Routing Devices</i>.</p>  |
| Two-way delay (usec)            | <p>For a two-way ETH-DM session, the frame delay time, in microseconds, measured at the initiator MEP.</p> <p>For a detailed description of two-way Ethernet frame delay measurement, see the <i>ITU-T Y.1731 Ethernet Service OAM</i> topics in the <i>Junos OS Network Interfaces Library for Routing Devices</i>.</p> |
| Average one-way delay           | Average one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                |
| Average one-way delay variation | Average one-way “frame jitter” for the statistics displayed.                                                                                                                                                                                                                                                             |
| Best-case one-way delay         | Lowest one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                 |
| Worst-case one-way delay        | Highest one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                |
| Average two-way delay           | Average two-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                |
| Average two-way delay variation | Average two-way “frame jitter” for the statistics displayed.                                                                                                                                                                                                                                                             |
| Best-case two-way delay         | Lowest two-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                 |
| Worst-case two-way delay        | Highest two-way frame delay calculated in this session.                                                                                                                                                                                                                                                                  |

## Sample Output

show oam ethernet connectivity-fault-  
management  
delay-statistics

```
user@switch> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md6 maintenance-association ma6
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
Remote MEP count: 2
Remote MEP identifier: 101
Remote MAC address: 00:05:85:73:39:4a
Delay measurement statistics:
Index  One-way delay  Two-way delay
      (usec)      (usec)
    1      259      519
    2      273      550
    3      287      571
    4      299      610
    5      313      650
Average one-way delay      : 286 usec
Average one-way delay variation: 62 usec
Best case one-way delay    : 259 usec
Worst case one-way delay   : 313 usec
Average two-way delay      : 580 usec
Average two-way delay variation: 26 usec
Best case two-way delay    : 519 usec
Worst case two-way delay   : 650 usec

Remote MEP identifier: 102
Remote MAC address: 00:04:55:63:39:5a
Delay measurement statistics:
Index  One-way delay  Two-way delay
      (usec)      (usec)
    1      29      58
    2      23      59
    3      27      56
    4      29      62
    5      33      68
Average one-way delay      : 28 usec
Average one-way delay variation: 3 usec
Best case one-way delay    : 23 usec
Worst case one-way delay   : 33 usec
Average two-way delay      : 60 usec
Average two-way delay variation: 3 usec
Best case two-way delay    : 56 usec
Worst case two-way delay   : 68 usec
```

show oam ethernet connectivity-fault-  
management delay-statistics remote-mep

```
user@switch> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md6 maintenance-association ma6 remote-mep 101
MEP identifier: 100, MAC address: 00:05:85:73:7b:39

Remote MEP identifier: 101
Remote MAC address: 00:05:85:73:39:4a
Delay measurement statistics:
Index  One-way delay  Two-way delay
      (usec)      (usec)
    1      259      519
```

|   |     |     |
|---|-----|-----|
| 2 | 273 | 550 |
| 3 | 287 | 571 |
| 4 | 299 | 610 |
| 5 | 313 | 650 |

Average one-way delay : 286 usec  
Average one-way delay variation: 62 usec  
Best case one-way delay : 259 usec  
Worst case one-way delay : 313 usec  
Average two-way delay : 580 usec  
Average two-way delay variation: 26 usec  
Best case two-way delay : 519 usec  
Worst case two-way delay : 650 usec

## show oam ethernet connectivity-fault-management forwarding-state

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet connectivity-fault-management forwarding-state</b><br><b>interface</b> <i>interface-name</i>   <b>instance</b> <i>instance-name</i><br><b>&lt;brief   detail   extensive&gt;</b>                                                                                                                                                                                                                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | On M7i and M10i with the Enhanced CFEB (CFEB-E), M320, MX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management forwarding state information for Ethernet interfaces.                                                                                                                                                                                                                              |
| <b>Options</b>                  | <p><b>interface</b> <i>interface-name</i>—Display forwarding state information for the specified Ethernet interface only.</p> <p><b>instance</b> <i>instance-name</i>—Display forwarding state information for the specified forwarding instance only.</p> <p><b>brief   detail   extensive</b>—(Optional) Display the specified level of output.</p>                                                                                                                           |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management forwarding-state instance on page 1721</a></p> <p><a href="#">show oam ethernet connectivity-fault-management forwarding-state interface on page 1721</a></p> <p><a href="#">show oam ethernet connectivity-fault-management forwarding-state interface detail on page 1722</a></p> <p><a href="#">show oam ethernet connectivity-fault-management forwarding-state interfaceinterface-name on page 1723</a></p> |
| <b>Output Fields</b>            | Table 123 on page 1720 lists the output fields for the <b>show oam ethernet connectivity-fault-management forwarding-state</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                 |

**Table 123: show oam ethernet connectivity-fault-management forwarding-state Output Fields**

| Field Name            | Field Description                        | Level of Output |
|-----------------------|------------------------------------------|-----------------|
| <b>Interface name</b> | Interface identifier.                    | All levels      |
| <b>Link (Status)</b>  | Local link status.                       | All levels      |
| <b>Filter action</b>  | Filter action for messages at the level. | All levels      |
| <b>Next hop type</b>  | Next-hop type.                           | All levels      |
| <b>Next index</b>     | Next-hop index number.                   | <b>brief</b>    |
| <b>Level</b>          | Maintenance domain (MD) level.           | <b>detail</b>   |

Table 123: show oam ethernet connectivity-fault-management forwarding-state Output Fields (*continued*)

| Field Name    | Field Description                        | Level of Output |
|---------------|------------------------------------------|-----------------|
| Direction     | MEP direction configured.                | none            |
| Instance name | Forwarding instance name.                | All levels      |
| CEs           | Number of customer edge (CE) interfaces. | All levels      |
| VEs           | Number of VPN endpoint (VE) interfaces.  | All levels      |

### Sample Output

show oam ethernet  
connectivity-fault-  
management forwarding-  
state instance

```
user@host> show oam ethernet connectivity-fault-management forwarding-state instance
Instance name: __+bd1__
CEs: 3
VEs: 0
Maintenance domain forwarding state:

Level   Direction   Filter action   Nexthop
         type
0        Drop        none
1        Drop        none
2        Drop        none
3        Drop        none
4        Drop        none
5        Drop        none
6        Drop        none
7        Drop        none
```

show oam ethernet  
connectivity-fault-  
management forwarding-  
state interface

```
user@host> show oam ethernet connectivity-fault-management forwarding-state interface
Interface name: ge-3/0/0.0
Instance name: __+bd1__
Maintenance domain forwarding state:

Level   Direction   Filter action   Nexthop
         type
0        Drop        none
1        Drop        none
2        Drop        none
3        Drop        none
4        Drop        none
5        Drop        none
6        Drop        none
7        down      Receive        none
```

Interface name: xe-0/0/0.0

Instance name: \_\_+bd1\_\_

Maintenance domain forwarding state:

| Level | Direction | Filter action | Nexthop type | Nexthop index |
|-------|-----------|---------------|--------------|---------------|
| 0     |           | Drop          | none         |               |
| 1     |           | Drop          | none         |               |
| 2     |           | Drop          | none         |               |
| 3     |           | Drop          | none         |               |
| 4     |           | Drop          | none         |               |
| 5     |           | Drop          | none         |               |
| 6     |           | Drop          | none         |               |
| 7     | down      | Receive       | none         |               |

**show oam ethernet  
connectivity-fault-  
management forwarding-  
state interface detail**

user@host> **show oam ethernet connectivity-fault-management forwarding-state interface detail**

Interface name: ge-3/0/0.0

Instance name: \_\_+bd1\_\_

Level: 0

Filter action: Drop

Nexthop type: none

Level: 1

Filter action: Drop

Nexthop type: none

Level: 2

Filter action: Drop

Nexthop type: none

Level: 3

Filter action: Drop

Nexthop type: none

Level: 4

Filter action: Drop

Nexthop type: none

Level: 5

Filter action: Drop

Nexthop type: none

Level: 6

Filter action: Drop

Nexthop type: none

Level: 7

Direction: down

Filter action: Receive

Nexthop type: none

Interface name: xe-0/0/0.0

Instance name: \_\_+bd1\_\_

```

Level: 0
Filter action: Drop
Nexthop type: none

```

```

Level: 1
Filter action: Drop
Nexthop type: none

```

```

...

```

```

show oam ethernet
connectivity-fault-
management forwarding-
state interface
interface-name

```

```

user@host> show oam ethernet connectivity-fault-management forwarding-state interface
interface-name ge-3/0/0/0.0
Interface name: ge-3/0/0.0
Instance name: __+bd1__
Maintenance domain forwarding state:

```

| Level | Direction | Filter action | Nexthop<br>type | Nexthop<br>index |
|-------|-----------|---------------|-----------------|------------------|
| 0     |           | Drop          | none            |                  |
| 1     |           | Drop          | none            |                  |
| 2     |           | Drop          | none            |                  |
| 3     |           | Drop          | none            |                  |
| 4     |           | Drop          | none            |                  |
| 5     |           | Drop          | none            |                  |
| 6     |           | Drop          | none            |                  |
| 7     | down      | Receive       | none            |                  |

## show oam ethernet connectivity-fault-management interfaces

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet connectivity-fault-management interfaces</b><br><b>&lt;ethernet-interface-name&gt;</b><br><b>&lt;level md-level&gt;</b><br><b>&lt;brief   detail   extensive&gt;</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.<br>Support for ITU-T Y.1731 frame delay measurement added in Junos OS Release 9.5.<br>Support for ITU-T Y.1731 Ethernet synthetic frame loss measurement (ETH-SLM) added in Junos OS Release 13.2 for ACX Series and MX Series routers.                                                                                                                                                                                                                                                                                                                                                           |
| <b>Description</b>              | <p>On M7i and M10i routers with Enhanced CFEB (CFEB-E), and on M320, MX Series, ACX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management (CFM) database information for Ethernet interfaces.</p> <p>In addition, for Ethernet interfaces on MX Series routers , also display any ITU-T Y.1731 frame delay measurement (ETH-DM) frame counts when <b>detail</b> or <b>extensive</b> mode is specified.</p> <p>For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.</p> |
| <b>Options</b>                  | <p><b>brief   detail   extensive</b>—(Optional) Specified level of output.</p> <p><b>ethernet-interface-name</b>—(Optional) CFM information only for CFM entities attached to the specified Ethernet interface.</p> <p><b>level md-level</b>—(Optional) CFM information for CFM identities enclosed within a maintenance domain of the specified level.</p>                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management delay-statistics on page 1716</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management mep-database on page 1742</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li><li>• <a href="#">Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 693</a></li></ul>                                                                               |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management interfaces on page 1729</a></p> <p><a href="#">show oam ethernet connectivity-fault-management interfaces detail on page 1730</a></p> <p><a href="#">show oam ethernet connectivity-fault-management interfaces detail (One-Way ETH-DM) on page 1731</a></p> <p><a href="#">show oam ethernet connectivity-fault-management interfaces detail (Connection Protection TLV Configured) on page 1731</a></p> <p><a href="#">show oam ethernet connectivity-fault-management interfaces extensive on page 1732</a></p>                                                             |



[show oam ethernet connectivity-fault-management interfaces level on page 1733](#)

[show oam ethernet connectivity-fault-management interfaces \(trunk ports\) on page 1733](#)

**Output Fields** Table 124 on page 1725 lists the output fields for the **show oam ethernet connectivity-fault-management interfaces** command. Output fields are listed in the approximate order in which they appear.

**Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields**

| Field Name                              | Field Description                                                                                                                                                                                                                                                                               | Level of Output         |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Interface</b>                        | Interface identifier.                                                                                                                                                                                                                                                                           | All levels              |
| <b>Interface status</b>                 | Local interface status.                                                                                                                                                                                                                                                                         | All levels              |
| <b>Link status</b>                      | Local link status. <b>Up</b> , <b>down</b> , or <b>oam-down</b> .                                                                                                                                                                                                                               | All levels              |
| <b>Maintenance domain name</b>          | Maintenance domain name.                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>Format (Maintenance domain)</b>      | Maintenance domain name format configured.                                                                                                                                                                                                                                                      | <b>detail extensive</b> |
| <b>Level</b>                            | Maintenance domain level configured.                                                                                                                                                                                                                                                            | All levels              |
| <b>Maintenance association name</b>     | Maintenance association name.                                                                                                                                                                                                                                                                   | <b>detail extensive</b> |
| <b>Format (Maintenance association)</b> | Maintenance association name format configured.                                                                                                                                                                                                                                                 | <b>detail extensive</b> |
| <b>Continuity-check status</b>          | Continuity-check status.                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>Ethernet-ais status</b>              | Status of alarm indication signal (AIS). <b>active</b> or <b>in-active</b> .                                                                                                                                                                                                                    | <b>detail extensive</b> |
| <b>Interval</b>                         | Continuity-check message interval.                                                                                                                                                                                                                                                              | <b>detail extensive</b> |
| <b>Loss-threshold</b>                   | Lost continuity-check message threshold.                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>Interface status TLV</b>             | Status of the interface status TLV, if configured on the MEP interface: <b>none</b> , <b>up</b> , <b>down</b> , <b>testing</b> , <b>unknown</b> , <b>dormant</b> , <b>notPresent</b> , <b>lowerLayerDown</b>                                                                                    | <b>detail extensive</b> |
| <b>Port status TLV</b>                  | Status of the port status TLV, if configured on the MEP interface: <b>none</b> , <b>no</b> , <b>yes</b>                                                                                                                                                                                         | <b>detail extensive</b> |
| <b>Connection Protection TLV</b>        | Status of the connection protection TLV if configured on the MEP interface: <b>no</b> , <b>yes</b><br><br>If <b>yes</b> , then the transmitted connection protection TLV is decoded and the following three fields are displayed: <b>Prefer me</b> , <b>Protection in use</b> , <b>FRR Flag</b> | <b>detail extensive</b> |

**Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields (*continued*)**

| Field Name                                  | Field Description                                                                                                                                                                                                               | Level of Output         |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Prefer me</b>                            | If set to <b>yes</b> , the path through which CCM was transmitted is preferred (unless the path fails). It is used for signaling a manual-switch command to the remote side.<br><br>Its value can be <b>yes</b> or <b>no</b> .  | <b>detail extensive</b> |
| <b>Protection in use</b>                    | Used for protection decision coordination. Its value is set to <b>yes</b> if the endpoint transmitting the CCM is currently transmitting the user traffic to protection path.<br><br>Its value can be <b>yes</b> or <b>no</b> . | <b>detail extensive</b> |
| <b>FRR Flag</b>                             | LSR/LER forwarding the CCM Frame into a bypass tunnel is set.<br><br>Its value can be <b>yes</b> or <b>no</b> .                                                                                                                 | <b>detail extensive</b> |
| <b>MEP identifier</b>                       | Maintenance association end point (MEP) identifier.                                                                                                                                                                             | All levels              |
| <b>Neighbors</b>                            | Number of MEP neighbors.                                                                                                                                                                                                        | All levels              |
| <b>Direction</b>                            | MEP direction configured.                                                                                                                                                                                                       | <b>detail extensive</b> |
| <b>MAC address</b>                          | MAC address configured for the MEP.                                                                                                                                                                                             | <b>detail extensive</b> |
| <b>MEP status</b>                           | Indicates the status of the connectivity fault management (CFM) protocol running on the MEP: <b>Running</b> , <b>inactive</b> , <b>disabled</b> , or <b>unsupported</b> .                                                       | <b>detail extensive</b> |
| <b>Remote MEP not receiving CCM</b>         | Whether the remote MEP is not receiving connectivity check messages (CCMs).                                                                                                                                                     | <b>detail extensive</b> |
| <b>Erroneous CCM received</b>               | Whether erroneous CCMs have been received.                                                                                                                                                                                      | <b>detail extensive</b> |
| <b>Cross-connect CCM received</b>           | Whether cross-connect CCMs have been received.                                                                                                                                                                                  | <b>detail extensive</b> |
| <b>RDI sent by some MEP</b>                 | Whether the remote defect indication (RDI) bit is set in messages that have been received. The absence of the RDI bit in a CCM indicates that the transmitting MEP is receiving CCMs from all configured MEPs.                  | <b>detail extensive</b> |
| <b>Some remote MEP's MAC in error state</b> | Indicates whether the remote MEP's MAC is in error state.                                                                                                                                                                       | <b>detail extensive</b> |
| <b>Alarm Indication Signal</b>              | Indicates whether the AIS is triggered or is cleared.                                                                                                                                                                           | <b>detail extensive</b> |
| <b>CCMs sent</b>                            | Number of CCMs transmitted.                                                                                                                                                                                                     | <b>detail extensive</b> |

**Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields (*continued*)**

| Field Name                                 | Field Description                                                                                                                                                                                                                   | Level of Output         |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>CCMs received out of sequence</b>       | Number of CCMs received out of sequence.                                                                                                                                                                                            | <b>detail extensive</b> |
| <b>LBM sent</b>                            | Number of loopback request messages (LBMs) sent.                                                                                                                                                                                    | <b>detail extensive</b> |
| <b>Valid in-order LBRs received</b>        | Number of loopback response messages (LBRs) received that were valid messages and in sequence.                                                                                                                                      | <b>detail extensive</b> |
| <b>Valid out-of-order LBRs received</b>    | Number of LBRs received that were valid messages and not in sequence.                                                                                                                                                               | <b>detail extensive</b> |
| <b>LBRs received with corrupted data</b>   | Number of LBRs received that were corrupted.                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>LBRs sent</b>                           | Number of LBRs transmitted.                                                                                                                                                                                                         | <b>detail extensive</b> |
| <b>LTM sent</b>                            | Linktrace messages (LTMs) transmitted.                                                                                                                                                                                              | <b>detail extensive</b> |
| <b>LTM received</b>                        | Linktrace messages received.                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>LTR sent</b>                            | Linktrace responses (LTRs) transmitted.                                                                                                                                                                                             | <b>detail extensive</b> |
| <b>LTR received</b>                        | Linktrace responses received.                                                                                                                                                                                                       | <b>detail extensive</b> |
| <b>Sequence number of next LTM request</b> | Sequence number of next LTM request to be transmitted.                                                                                                                                                                              | <b>detail extensive</b> |
| <b>1DMs sent</b>                           | <p>If the interface is attached to an initiator MEP for a one-way ETH-DM session: Number of one-way delay measurement (1DM) PDU frames sent to the peer MEP in this session.</p> <p>For all other cases, this field displays 0.</p> | <b>detail extensive</b> |
| <b>Valid 1DMs received</b>                 | <p>If the interface is attached to a receiver MEP for a one-way ETH-DM session: Number of valid 1DM frames received.</p> <p>For all other cases, this field displays 0.</p>                                                         | <b>detail extensive</b> |
| <b>Invalid 1DMs received</b>               | <p>If the interface is attached to a receiver MEP for a one-way ETH-DM session: Number of invalid 1DM frames received.</p> <p>For all other cases, this field displays 0.</p>                                                       | <b>detail extensive</b> |
| <b>Out of sync 1DMs received</b>           | <p>If the interface is attached to a receiver MEP for a one-way ETH-DM session: Number of out-of-sync one-way delay measurement request packets received.</p>                                                                       | <b>detail extensive</b> |

**Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields (*continued*)**

| Field Name                          | Field Description                                                                                                                                                                                                                    | Level of Output         |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>DMMs sent</b>                    | If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of Delay Measurement Message (DMM) PDU frames sent to the peer MEP in this session.<br><br>For all other cases, this field displays <b>0</b> . | <b>detail extensive</b> |
| <b>Valid DMMs received</b>          | If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of valid two-way delay measurement request packets received.                                                                                   | <b>detail extensive</b> |
| <b>Invalid DMMs received</b>        | If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of invalid two-way delay measurement request packets received.                                                                                 | <b>detail extensive</b> |
| <b>DMRs sent</b>                    | If the interface is attached to a responder MEP for a two-way ETH-DM session: Number of delay measurement reply (DMR) frames sent.<br><br>For all other cases, this field displays <b>0</b> .                                        | <b>detail extensive</b> |
| <b>Valid DMRs received</b>          | If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of valid DMRs received.<br><br>For all other cases, this field displays <b>0</b> .                                                             | <b>detail extensive</b> |
| <b>Invalid DMRs received</b>        | If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of invalid DMRs received.<br><br>For all other cases, this field displays <b>0</b> .                                                           | <b>detail extensive</b> |
| <b>LMM sent</b>                     | If the interface is attached to an initiator MEP for a ETH-LM session: Number of loss measurement message (LMM) PDU frames sent to the peer MEP in this session.                                                                     | <b>detail extensive</b> |
| <b>Valid LMM received</b>           | If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid loss measurement request packets received.                                                                                                    | <b>detail extensive</b> |
| <b>Invalid LMM received</b>         | If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid loss measurement request packets received.                                                                                                  | <b>detail extensive</b> |
| <b>LMR sent</b>                     | If the interface is attached to a responder MEP for a ETH-LM session: Number of loss measurement reply (LMR) frames sent.                                                                                                            | <b>detail extensive</b> |
| <b>Valid LMR received</b>           | If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid LMR frames received.                                                                                                                          | <b>detail extensive</b> |
| <b>Invalid LMR received</b>         | If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid LMR frames received.                                                                                                                        | <b>detail extensive</b> |
| <b>Valid AIS frames transmitted</b> | Number of valid AIS frames transmitted to the peer MEPs.                                                                                                                                                                             | <b>detail extensive</b> |

**Table 124: show oam ethernet connectivity-fault-management interfaces Output Fields (continued)**

| Field Name                | Field Description                                                                                                                                                                                                    | Level of Output  |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Valid AIS frames received | Number of valid AIS frames received from the peer MEPs.                                                                                                                                                              | detail extensive |
| SLM sent                  | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of synthetic loss measurement (SLM) request packets transmitted from the source MEP to the remote or destination MEP in this session. | detail extensive |
| Valid SLM received        | If the interface is attached to a responder MEP for a ETH-SLM session: Number of valid SLM PDUs transmitted from the source MEP to the remote or destination MEP.                                                    | detail extensive |
| Invalid SLM received      | If the interface is attached to a responder MEP for a ETH-SLM session: Number of invalid SLM PDUs transmitted from the source MEP to the remote or destination MEP.                                                  | detail extensive |
| SLR sent                  | If the interface is attached to a responder MEP for a ETH-SLM session: Number detail extensive of synthetic loss reply (SLR) frames sent.                                                                            | detail extensive |
| Valid SLR received        | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of valid SLR PDUs that the source MEP received from the remote or destination MEP.                                                    | detail extensive |
| Invalid SLR received      | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of invalid SLR PDUs that the source MEP received from the remote or destination MEP.                                                  | detail extensive |
| Remote MEP count          | Number of remote MEPs.                                                                                                                                                                                               | extensive        |
| Identifier (remote MEP)   | MEP identifier of the remote MEP.                                                                                                                                                                                    | extensive        |
| MAC address (remote MEP)  | MAC address of the remote MEP.                                                                                                                                                                                       | extensive        |
| State (remote MEP)        | State of the remote MEP.                                                                                                                                                                                             | extensive        |
| Interface (remote MEP)    | Interface of the remote MEP.                                                                                                                                                                                         | extensive        |

## Sample Output

**show oam ethernet connectivity-fault-management interfaces**

```

user@host> show oam ethernet connectivity-fault-management interfaces
Interface      Link      Status      Level      MEP      Neighbors
               Identifier
ge-1/1/0.0     Up        Active      0          2        1
ge-1/1/0.1     Up        Active      0          2        1

```

|              |    |        |   |   |   |
|--------------|----|--------|---|---|---|
| ge-1/1/0.10  | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.100 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.101 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.102 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.103 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.104 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.105 | Up | Active | 0 | 2 | 1 |
| ge-1/1/0.106 | Up | Active | 0 | 2 | 1 |

...

### show oam ethernet connectivity-fault-management interfaces detail

```

user@host> show oam ethernet connectivity-fault-management interfaces detail
Interface name: ge-5/2/9.0, Interface status: Active, Link status: Up
Maintenance domain name: md0, Format: string, Level: 5
Maintenance association name: ma1, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 1, Direction: down, MAC address: 00:90:69:0b:4b:94
MEP status: running
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : yes
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : yes
  Alarm Indication Signal                     : yes
Statistics:
  CCMs sent                                  : 76
  CCMs received out of sequence               : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received                : 0
  Valid out-of-order LBRs received            : 0
  LBRs received with corrupted data           : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                              : 0
  LTRs sent                                  : 0
  LTRs received                              : 0
  Sequence number of next LTM request         : 1320235363

  1DMs sent                                  : 0
  Valid 1DMs received                        : 0
  Invalid 1DMs received                      : 0
  DMMs sent                                  : 0
  DMRs sent                                  : 0
  Valid DMRs received                       : 0
  Invalid DMRs received                     : 0
  LMM sent                                  : 10
  Valid LMM received                        : 20
  Invalid LMM received                      : 0
  LMR sent                                  : 20
  Valid LMR received                        : 10
  Invalid LMR received                      : 0
  Valid AIS frames transmitted               : 0
  Valid AIS frames received                 : 0
  SLM sent                                  : 10
  Valid SLM received                        : 20
  Invalid SLM received                      : 0
  SLR sent                                  : 20
  Valid SLR received                        : 10

```

```

Invalid SLR received : 0
Remote MEP count: 2
Identifier    MAC address    State    Interface
2001         00:90:69:0b:7f:71    ok       ge-5/2/9.0
4001         00:90:69:0b:09:c5    ok       ge-5/2/9.0

```

#### show oam ethernet connectivity-fault-management interfaces detail (One-Way ETH-DM)

```

user@host show oam ethernet connectivity-fault-management interfaces detail
Interface name: ge-0/2/5.0, Interface status: Active, Link status: Up
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 101, Direction: down, MAC address: 00:90:69:0a:48:57
MEP status: running
Defects:
Remote MEP not receiving CCM : no
Erroneous CCM received : no
Cross-connect CCM received : no
RDI sent by some MEP : no
Statistics:
CCMs sent : 1590
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 1542035464

1DMs sent : 10
Valid 1DMs received : 0
Invalid 1DMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0
Remote MEP count: 1
Identifier    MAC address    State    Interface
201          00:90:69:0a:43:94    ok       ge-0/2/5.0

```

#### show oam ethernet connectivity-fault-management interfaces detail (Connection Protection TLV Configured)

```

user@host show oam ethernet connectivity-fault-management interfaces detail
Interface name: xe-6/2/0.0 , Interface status: Active, Link status: Up
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: yes
Prefer me: no, Protection in use: no, FRR Flag: no
MEP identifier: 1, Direction: down, MAC address: 00:19:e2:b1:14:30
MEP status: running

```

```

Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : no
  Some remote MEP's MAC in error state        : no
Statistics:
  CCMs sent                                  : 225
  CCMs received out of sequence               : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received                : 0
  Valid out-of-order LBRs received            : 0
  LBRs received with corrupted data           : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                              : 0
  LTRs sent                                  : 0
  LTRs received                              : 0
  Sequence number of next LTM request         : 1244305646

  1DMs sent                                  : 0
  Valid 1DMs received                        : 0
  Invalid 1DMs received                      : 0
  Out of sync 1DMs received                  : 0
  DMMs sent                                  : 0
  Valid DMMs received                       : 0
  Invalid DMMs received                     : 0
  DMRs sent                                  : 0
  Valid DMRs received                       : 0
  Invalid DMRs received                     : 0
  LMMs sent                                  : 0
  Valid LMMs received                       : 0
  Invalid LMMs received                     : 0
  LMRs sent                                  : 0
  Valid LMRs received                       : 0
  Invalid LMRs received                     : 0
Remote MEP count: 1
  Identifier  MAC address      State  Interface
    2         00:90:69:7f:e4:30

```

#### show oam ethernet connectivity-fault-management interfaces extensive

```

user@host> show oam ethernet connectivity-fault-management interfaces extensive
Interface name: ge-5/2/9.0, Interface status: Active, Link status: Up
Maintenance domain name: md0, Format: string, Level: 5
Maintenance association name: ma1, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no
MEP identifier: 1, Direction: down, MAC address: 00:90:69:0b:4b:94
MEP status: running
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : yes
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : yes

  Alarm Indication Signal                     : yes
Statistics:

```



```

CCMs sent : 76
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 1645032434

1DMs sent : 0
Valid 1DMs received : 0
Invalid 1DMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0

Valid AIS frames transmitted : 0
Valid AIS frames received : 0
SLM sent : 10
Valid SLM received : 20
Invalid SLM received : 0
SLR sent : 20
Valid SLR received : 10
Invalid SLR received : 0
Remote MEP count: 2
Identifier  MAC address      State  Interface
2001      00:90:69:0b:7f:71      ok    ge-5/2/9.0
4001      00:90:69:0b:09:c5      ok    ge-5/2/9.0

```

#### show oam ethernet connectivity-fault-management interfaces level

```

user@host> show oam ethernet connectivity-fault-management interfaces level 7
Interface      Link      Status      Level  MEP      Neighbors
Identifier
ge-3/0/0.0     Up        Active      7      201      0
xe-0/0/0.0     Up        Active      7      203      1

```

#### show oam ethernet connectivity-fault-management interfaces (trunk ports)

```

user@host> show oam ethernet connectivity-fault-management interfaces

Interface      Link      Status      Level  MEP      Neighbors
Identifier
ge-4/0/1.0, vlan 100      Up        Active      5      100      0
ge-10/3/10.4091, vlan 4091 Down      Inactive    4      400      0
ge-4/0/0.0          Up        Active      6      200      0

user@host> show oam ethernet connectivity-fault-management interfaces ge-4/0/0.0

Interface      Link      Status      Level  MEP      Neighbors
Identifier
ge-4/0/0.0     Up        Active      6      200      0

```

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-4/0/1.0 vlan 100
```

| Interface            | Link | Status | Level | MEP Identifier | Neighbors |
|----------------------|------|--------|-------|----------------|-----------|
| ge-4/0/1.0, vlan 100 | Up   | Active | 5     | 100            | 0         |

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-10/3/10.4091  
vlan 4091
```

| Interface                  | Link | Status   | Level | MEP Identifier | Neighbors |
|----------------------------|------|----------|-------|----------------|-----------|
| ge-10/3/10.4091, vlan 4091 | Down | Inactive | 4     | 400            | 0         |

## show oam ethernet connectivity-fault-management linktrace path-database

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet connectivity-fault-management linktrace path-database mac-address maintenance-association <i>ma-name</i> maintenance-domain <i>md-name</i></b>                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.0.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | On M320, MX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management maintenance linktrace database information.                                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <p><b>mac-address</b>—Display connectivity fault management path database information for the specified MAC address of the remote host.</p> <p><b>maintenance-association <i>ma-name</i></b>—Display connectivity fault management path database information for the specified maintenance association.</p> <p><b>maintenance-domain <i>md-name</i></b>—Display connectivity fault management path database information for the specified maintenance domain.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management linktrace path-database on page 1736</a></p> <p><a href="#">show oam ethernet connectivity-fault-management linktrace path-database (Two traceroute Commands) on page 1736</a></p>                                                                                                                                                                                                                 |
| <b>Output Fields</b>            | Table 125 on page 1735 lists the output fields for the <b>show oam ethernet connectivity-fault-management linktrace path-database</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                            |

**Table 125: show oam ethernet connectivity-fault-management linktrace path-database Output Fields**

| Field Name                     | Field Description                                                           |
|--------------------------------|-----------------------------------------------------------------------------|
| <b>Linktrace to</b>            | MAC address of the 802.1ag node to which the linktrace message is targeted. |
| <b>Interface</b>               | Interface used by the local MEP to send the linktrace message (LTM).        |
| <b>Maintenance Domain</b>      | Maintenance domain identifier specified in the traceroute command.          |
| <b>Maintenance Association</b> | Maintenance association identifier specified in the traceroute command.     |
| <b>Level</b>                   | Maintenance domain level configured for the maintenance domain.             |
| <b>Local Mep</b>               | MEP identifier of the local MEP originating the linktrace.                  |
| <b>Hop</b>                     | Sequential hop count of the linktrace path.                                 |

Table 125: show oam ethernet connectivity-fault-management linktrace path-database Output Fields (*continued*)

| Field Name             | Field Description                                                                                                                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TTL                    | Number of hops remaining in the linktrace message (LTM). The time to live (TTL) is decremented at each hop.                                                                                                                                                                   |
| Source MAC address     | MAC address of the 802.1ag node responding to the LTM or the source MAC address of the LTR.                                                                                                                                                                                   |
| Next hop MAC address   | MAC address of the egress interface of the node to which the LTM is forwarded or the next-hop MAC address derived from the next egress identifier in the Egress-ID TLV of the LTR PDU.                                                                                        |
| Transaction Identifier | 4-byte identifier maintained by the MEP. Each LTM uses a transaction identifier. The transaction identifier is maintained globally across all maintenance domains. Use the transaction identifier to match an incoming linktrace responses (LTR), with a previously sent LTM. |

## Sample Output

### show oam ethernet connectivity-fault-management linktrace path-database

```
user@host> show oam ethernet connectivity-fault-management linktrace path-database
maintenance-domain MD1 maintenance-association MA1 00:01:02:03:04:05
Linktrace to 00:01:02:03:04:05, Interface : ge-5/0/0.0
Maintenance Domain: MD1, Level: 7
Maintenance Association: MA1, Local Mep: 1
```

| Hop                           | TTL | Source MAC address | Next hop MAC address |
|-------------------------------|-----|--------------------|----------------------|
| Transaction Identifier:100001 |     |                    |                      |
| 1                             | 63  | 00:00:aa:aa:aa:aa  | 00:00:ab:ab:ab:ab    |
| 2                             | 62  | 00:00:bb:bb:bb:bb  | 00:00:bc:bc:bc:bc    |
| 3                             | 61  | 00:00:cc:cc:cc:cc  | 00:00:cd:cd:cd:cd    |
| 4                             | 60  | 00:01:02:03:04:05  | 00:00:00:00:00:00    |

### show oam ethernet connectivity-fault-management linktrace path-database (Two traceroute Commands)

```
user@host> traceroute ethernet maintenance-domain md1 maintenance-association ma1
00:01:02:03:04:05
Linktrace to 00:01:02:03:04:05, Interface : ge-5/0/0.0
Maintenance Domain: MD1, Level: 7
Maintenance Association: MA1, Local Mep: 1
```

| Hop                           | TTL | Source MAC address | Next hop MAC address |
|-------------------------------|-----|--------------------|----------------------|
| Transaction Identifier:100002 |     |                    |                      |
| 1                             | 63  | 00:00:aa:aa:aa:aa  | 00:00:ab:ab:ab:ab    |
| 2                             | 62  | 00:00:bb:bb:bb:bb  | 00:00:bc:bc:bc:bc    |
| 3                             | 61  | 00:00:cc:cc:cc:cc  | 00:00:cd:cd:cd:cd    |
| 4                             | 60  | 00:01:02:03:04:05  | 00:00:00:00:00:00    |
| Transaction Identifier:100003 |     |                    |                      |
| 1                             | 63  | 00:00:aa:aa:aa:aa  | 00:00:ab:ab:ab:ab    |

|   |    |                   |                   |
|---|----|-------------------|-------------------|
| 2 | 62 | 00:00:bb:bb:bb:bb | 00:00:bc:bc:bc:bc |
| 3 | 61 | 00:00:cc:cc:cc:cc | 00:00:cd:cd:cd:cd |
| 4 | 60 | 00:01:02:03:04:05 | 00:00:00:00:00:00 |

## show oam ethernet connectivity-fault-management loss-statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show oam ethernet connectivity-fault-management loss-statistics maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> &lt;count <i>entry-count</i>&gt; &lt;local-mep <i>local-mep-id</i>&gt; &lt;remote-mep <i>remote-mep-id</i>&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Description</b>              | On MX Series and ACX series routers with Ethernet interfaces, display ETH-LM statistics for on-demand mode only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Options</b>                  | <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing CFM maintenance domain.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association.</p> <p><b>count <i>entry-count</i></b>—(Optional) Number of entries to display from the statistics table. The range of values is from 1 through 100. The default value is 100.</p> <p><b>local-mep <i>local-mep-id</i></b>—(Optional) Numeric identifier of the local MEP. The range of values is from 1 through 8191.</p> <p><b>remote-mep <i>remote-mep-id</i></b>—(Optional) Numeric identifier of the remote MEP. The range of values is from 1 through 8191.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Output Fields</b>            | <a href="#">Table 126 on page 1738</a> lists the output fields for the <b>show oam ethernet connectivity-fault-management loss-statistics</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Table 126: show oam ethernet connectivity-fault-management loss-statistics Output Fields

| Output Field Name     | Field Description                                                        |
|-----------------------|--------------------------------------------------------------------------|
| MEP identifier        | Maintenance association end point (MEP) numeric identifier.              |
| MAC address           | Unicast MAC address configured for the MEP.                              |
| Remote MEP count      | Number of remote MEPs (unless you specify the <b>remote-mep</b> option). |
| Remote MEP identifier | Numeric identifier of the remote MEP.                                    |
| Remote MAC address    | Unicast MAC address of the remote MEP.                                   |
| Index                 | Index number that corresponds to the ETH-LM entry in the CFM database.   |

**Table 126: show oam ethernet connectivity-fault-management loss-statistics Output Fields (*continued*)**

| Output Field Name              | Field Description                                                                                                                                                              |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Near-end frame loss            | Count of frame loss associated with ingress data frames.                                                                                                                       |
| Far-end frame loss             | Count of frame loss associated with egress data frames.                                                                                                                        |
| Near-end loss ratio            | Ratio, expressed as a percentage, of the number of service frames not delivered divided by the total number of service frames during time interval T at the ingress interface. |
| Far-end loss ratio             | Ratio, expressed as a percentage, of the number of service frames not delivered divided by the total number of service frames during time interval T at the egress interface.  |
| Average near-end frame loss    | Average frame loss measured in this session associated with ingress data frames.                                                                                               |
| Average near-end loss ratio    | Average frame loss ratio measured in this session associated with ingress data frames.                                                                                         |
| Average far-end frame loss     | Average frame loss measured in this session associated with egress data frames.                                                                                                |
| Average far-end loss ratio     | Average frame loss ratio measured in this session associated with egress data frames.                                                                                          |
| Near-end best case loss        | Lowest frame loss measured in this session associated with ingress data frames.                                                                                                |
| Near-end best case loss ratio  | Lowest frame loss ratio measured in this session associated with ingress data frames.                                                                                          |
| Near-end worst case loss       | Highest frame loss measured in this session associated with ingress data frames.                                                                                               |
| Near-end worst case loss ratio | Highest frame loss ratio measured in this session associated with ingress data frames.                                                                                         |
| Far-end best case frame loss   | Lowest frame loss measured in this session associated with egress data frames.                                                                                                 |
| Far-end best case loss ratio   | Lowest frame loss ratio measured in this session associated with egress data frames.                                                                                           |
| Far-end worst case loss        | Highest frame loss measured in this session associated with egress data frames.                                                                                                |
| Far-end worst case loss ratio  | Highest frame loss ratio measured in this session associated with egress data frames.                                                                                          |

### show oam ethernet connectivity fault management loss statistics

```

user@host> . show oam ethernet connectivity fault management loss statistics
maintenance-domain md maintenance-association ma
MEP identifier: 1, MAC address: 64:87:88:f9:7d:1b
Remote MEP count: 1

```

Remote MAC address: 64:87:88:6a:da:94

LM client session-id:4843

CIR Loss measurement statistics:

| Index    | Near-end   | Far-end  | Near-end | Far-end    | Near-end |
|----------|------------|----------|----------|------------|----------|
| Far-end  |            |          |          |            |          |
|          | Frame loss | Total tx | Total rx | Frame loss | Total tx |
| Total rx |            |          |          |            |          |
| (CIR)    | (CIR)      | (CIR)    | (CIR)    | (CIR)      | (CIR)    |
| 1        | 0          | 245      | 245      | 0          | 244      |
| 244      |            |          |          |            |          |
| 2        | 0          | 488      | 488      | 0          | 489      |
| 489      |            |          |          |            |          |
| 3        | 0          | 732      | 732      | 0          | 733      |
| 733      |            |          |          |            |          |
| 4        | 0          | 977      | 977      | 0          | 976      |
| 976      |            |          |          |            |          |

EIR Loss measurement statistics:

| Index    | Near-end   | Far-end  | Near-end | Far-end    | Near-end |
|----------|------------|----------|----------|------------|----------|
| Far-end  |            |          |          |            |          |
|          | Frame loss | Total tx | Total rx | Frame loss | Total tx |
| Total rx |            |          |          |            |          |
| (EIR)    | (EIR)      | (EIR)    | (EIR)    | (EIR)      | (EIR)    |
| 1        | 0          | 272      | 272      | 0          | 273      |
| 273      |            |          |          |            |          |
| 2        | 0          | 546      | 546      | 0          | 545      |
| 545      |            |          |          |            |          |
| 3        | 0          | 820      | 820      | 0          | 819      |
| 819      |            |          |          |            |          |
| 4        | 0          | 1092     | 1092     | 0          | 1093     |
| 1093     |            |          |          |            |          |

```

Total far-end Tx (CIR)           : 977
Total near-end Rx (CIR)          : 977
Total near-end loss(CIR)         : 0
Total near-end loss ratio(CIR)   : 0.00000%
Total near-end Tx (CIR)          : 976
Total far-end Rx (CIR)           : 976
Total far-end loss(CIR)          : 0
Total far-end loss ratio(CIR)    : 0.00000%
Average near-end loss(CIR)       : 0.00000
Average near-end loss ratio(CIR) : 0.00000%
Average far-end loss(CIR)        : 0.00000
Average far-end loss ratio(CIR)  : 0.00000%
Near-end best case loss(CIR)     : 0
Near-end best case loss ratio(CIR) : 0.00000%
Near-end worst case loss(CIR)    : 0
Near-end worst case loss ratio(CIR): 0.00000%
Far-end best case loss(CIR)      : 0
Far-end best case loss ratio(CIR) : 0.00000%
Far-end worst case loss(CIR)     : 0
Far-end worst case loss ratio(CIR): 0.00000%
Total far-end Tx (EIR)           : 1092
Total near-end Rx (EIR)          : 1092
Total near-end loss(EIR)         : 0
Total near-end loss ratio(EIR)   : 0.00000%
Total near-end Tx (EIR)          : 1093
Total far-end Rx (EIR)           : 1093
Total far-end loss(EIR)          : 0

```



```
Total far-end loss ratio(EIR)      : 0.00000%
Average near-end loss(EIR)         : 0.00000
Average near-end loss ratio(EIR)   : 0.00000%
Average far-end loss(EIR)          : 0.00000
Average far-end loss ratio(EIR)    : 0.00000%
Near-end best case loss(EIR)       : 0
Near-end best case loss ratio(EIR) : 0.00000%
Near-end worst case loss(EIR)      : 0
Near-end worst case loss ratio(EIR): 0.00000%
Far-end best case loss(EIR)        : 0
Far-end best case loss ratio(EIR)  : 0.00000%
Far-end worst case loss(EIR)       : 0
Far-end worst case loss ratio(EIR) : 0.00000%
```

## show oam ethernet connectivity-fault-management mep-database

---

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet connectivity-fault-management mep-database</b><br><b>maintenance-domain</b> <i>domain-name</i><br><b>maintenance-association</b> <i>ma-name</i><br><b>&lt;local-mep</b> <i>local-mep-id</i><br><b>&lt;remote-mep</b> <i>remote-mep-id</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.<br>Support for ITU-T Y.1731 frame delay measurement added in Junos OS Release 9.5.<br>Support for ITU-T Y.1731 synthetic frame loss measurement added in Junos OS Release 13.2 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | <p>On M7i and M10i routers with Enhanced CFEB (CFEB-E), and on M320, M120, MX Series, ACX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management (CFM) database information for CFM maintenance association end points (MEPs) in a CFM session.</p> <p>In addition, on M120, M320, and MX series routers, also display port status TLV, interface status TLV, and action profile information.</p> <p>In addition, for Ethernet interfaces on MX Series routers , also display any ITU-T Y.1731 frame delay measurement (ETH-DM) frame counts.</p> <p>For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.</p> |
| <b>Options</b>                  | <p><b>maintenance-association</b> <i>ma-name</i>—Name of the maintenance association.</p> <p><b>maintenance-domain</b> <i>domain-name</i>—Name of the maintenance domain.</p> <p><b>local-mep-id</b>—(Optional) Numeric identifier of local MEP.</p> <p><b>remote-mep-id</b>—(Optional) Numeric identifier of the remote MEP.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"><li>• <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management delay-statistics on page 1716</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management interfaces on page 1724</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li></ul>                                                                                                                                                                                                                                                                                                                          |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management mep-database on page 1747</a></p> <p><a href="#">show oam ethernet connectivity-fault-management mep-database (One-Way ETH-DM) on page 1748</a></p> <p><a href="#">show oam ethernet connectivity-fault-management mep-database local-mep remote-mep on page 1749</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                            |

[show oam ethernet connectivity-fault-management mep-database remote-mep \(Action Profile Event\) on page 1749](#)

[show oam ethernet connectivity-fault-management mep-database \(Connection Protection TLV Configured\) on page 1749](#)

[show oam ethernet connectivity-fault-management mep-database on page 1750](#)

[show oam ethernet connectivity-fault-management mep-database \(enhanced continuity measurement\) on page 1751](#)

**Output Fields** [Table 127 on page 1743](#) lists the output fields for the **show oam ethernet connectivity-fault-management mep-database** command. Output fields are listed in the approximate order in which they appear.

**Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields**

| Field Name                       | Field Description                                                                                                                                                                                                                                                                                |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maintenance domain name          | Maintenance domain name.                                                                                                                                                                                                                                                                         |
| Format (Maintenance domain)      | Maintenance domain name format configured.                                                                                                                                                                                                                                                       |
| Level                            | Maintenance domain level configured.                                                                                                                                                                                                                                                             |
| Maintenance association name     | Maintenance association name.                                                                                                                                                                                                                                                                    |
| Format (Maintenance association) | Maintenance association name format configured.                                                                                                                                                                                                                                                  |
| Continuity-check status          | Continuity-check status.                                                                                                                                                                                                                                                                         |
| Interval                         | Continuity-check message interval.                                                                                                                                                                                                                                                               |
| Loss-threshold                   | Lost continuity-check message threshold.                                                                                                                                                                                                                                                         |
| Connection Protection TLV        | Status of the connection protection TLV, if configured on the MEP interface: <b>no</b> , <b>yes</b><br><br>If <b>yes</b> , then the transmitted connection protection TLV is decoded and the following three fields are displayed: <b>Prefer me</b> , <b>Protection in use</b> , <b>FRR Flag</b> |
| Prefer me                        | If set to <b>yes</b> , the path through which CCM was transmitted is preferred (unless the path fails). It is used for signaling a manual-switch command to remote side.<br><br>Its value can be <b>yes</b> or <b>no</b> .                                                                       |
| Protection in use                | Used for protection decision coordination. Its value is set to <b>yes</b> if the endpoint transmitting the CCM is currently transmitting the user traffic to protection path.<br><br>Its value can be <b>yes</b> or <b>no</b> .                                                                  |
| FRR Flag                         | LSR/LER forwarding the CCM Frame into a bypass tunnel is set.<br><br>Its value can be <b>yes</b> or <b>no</b> .                                                                                                                                                                                  |

Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields (*continued*)

| Field Name                           | Field Description                                                                                                                                                                                              |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MEP identifier</b>                | Maintenance association end point (MEP) identifier.                                                                                                                                                            |
| <b>Direction</b>                     | MEP direction configured.                                                                                                                                                                                      |
| <b>MAC address</b>                   | MAC address configured for the MEP.                                                                                                                                                                            |
| <b>Auto-discovery</b>                | Whether automatic discovery is enabled or disabled.                                                                                                                                                            |
| <b>Priority</b>                      | Priority used for CCMs and linktrace messages transmitted by the MEP.                                                                                                                                          |
| <b>Interface name</b>                | Interface identifier.                                                                                                                                                                                          |
| <b>Interface status</b>              | Local interface status.                                                                                                                                                                                        |
| <b>Link status</b>                   | Local link status.                                                                                                                                                                                             |
| <b>Remote MEP not receiving CCM</b>  | Whether the remote MEP is not receiving CCMs.                                                                                                                                                                  |
| <b>Erroneous CCM received</b>        | Whether erroneous CCMs have been received.                                                                                                                                                                     |
| <b>Cross-connect CCM received</b>    | Whether cross-connect CCMs have been received.                                                                                                                                                                 |
| <b>RDI sent by some MEP</b>          | Whether the remote defect indication (RDI) bit is set in messages that have been received. The absence of the RDI bit in a CCM indicates that the transmitting MEP is receiving CCMs from all configured MEPs. |
| <b>CCMs sent</b>                     | Number of CCMs transmitted.                                                                                                                                                                                    |
| <b>CCMs received out of sequence</b> | Number of CCMs received out of sequence.                                                                                                                                                                       |
| <b>LBMs sent</b>                     | Number of loopback messages (LBMs) sent.                                                                                                                                                                       |
| <b>Valid in-order LBRs received</b>  | Number of loopback response messages (LBRs) received that were valid messages and in sequence.                                                                                                                 |
| <b>1DMs sent</b>                     | <p>If the MEP is an initiator for a one-way ETH-DM session: Number of one-way delay measurement (1DM) PDU frames sent to the peer MEP in this session.</p> <p>For all other cases, this field displays 0.</p>  |
| <b>Valid 1DMs received</b>           | <p>If the MEP is a receiver for a one-way ETH-DM session: Number of valid 1DM frames received.</p> <p>For all other cases, this field displays 0.</p>                                                          |

**Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields (*continued*)**

| Field Name                                 | Field Description                                                                                                                                                                                      |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Invalid 1DMs received</b>               | If the MEP is a receiver for a one-way ETH-DM session: Number of invalid 1DM frames received.<br><br>For all other cases, this field displays 0.                                                       |
| <b>Out of sync 1DMs received</b>           | If the MEP is a receiver for a one-way ETH-DM session: Number of out-of-sync one-way delay measurement request packets received.                                                                       |
| <b>DMMs sent</b>                           | If the MEP is an initiator for a two-way ETH-DM session: Number of Delay Measurement Message (DMM) PDU frames sent to the peer MEP in this session.<br><br>For all other cases, this field displays 0. |
| <b>Valid DMMs received</b>                 | If the MEP is an initiator for a two-way ETH-DM session: Number of valid two-way delay measurement packets received.                                                                                   |
| <b>Invalid DMMs received</b>               | If the MEP is an initiator for a two-way ETH-DM session: Number of invalid two-way delay measurement packets received.                                                                                 |
| <b>DMRs sent</b>                           | If the MEP is a responder for a ETH-DM session: Number of Delay Measurement Reply (DMR) frames sent.<br><br>For all other cases, this field displays 0.                                                |
| <b>Valid DMRs received</b>                 | If the MEP is an initiator for a two-way ETH-DM session: Number of valid DMRs received.<br><br>For all other cases, this field displays 0.                                                             |
| <b>Invalid DMRs received</b>               | If the MEP is an initiator for a two-way ETH-DM session: Number of invalid DMRs received.<br><br>For all other cases, this field displays 0.                                                           |
| <b>Valid out-of-order LBRs received</b>    | Number of LBRs received that were valid messages and not in sequence.                                                                                                                                  |
| <b>LBRs received with corrupted data</b>   | Number of LBRs received that were corrupted.                                                                                                                                                           |
| <b>LBRs sent</b>                           | Number of LBRs transmitted.                                                                                                                                                                            |
| <b>LTMs sent</b>                           | Linktrace messages (LTMs) transmitted.                                                                                                                                                                 |
| <b>LTMs received</b>                       | Linktrace messages received.                                                                                                                                                                           |
| <b>LTRs sent</b>                           | Linktrace responses (LTRs) transmitted.                                                                                                                                                                |
| <b>LTRs received</b>                       | Linktrace responses received.                                                                                                                                                                          |
| <b>Sequence number of next LTM request</b> | Sequence number of the next linktrace message request to be transmitted.                                                                                                                               |

Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields (*continued*)

| Field Name                   | Field Description                                                                                                                                                                                                    |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LMM sent</b>              | If the interface is attached to an initiator MEP for a ETH-LM session: Number of loss measurement message (LMM) PDU frames sent to the peer MEP in this session.                                                     |
| <b>Valid LMM received</b>    | If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid loss measurement request packets received.                                                                                    |
| <b>Invalid LMM received</b>  | If the interface is attached to an initiator MEP for a ETH LM session: Number of invalid loss measurement request packets received.                                                                                  |
| <b>LMR sent</b>              | If the interface is attached to a responder MEP for a ETH-LM session: Number of loss measurement reply (LMR) frames sent.                                                                                            |
| <b>Valid LMR received</b>    | If the interface is attached to an initiator MEP for a ETH LM session: Number of valid LMR frames received.                                                                                                          |
| <b>Invalid LMR received</b>  | If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid LMR frames received.                                                                                                        |
| <b>SLM sent</b>              | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of synthetic loss measurement (SLM) request packets transmitted from the source MEP to the remote or destination MEP in this session. |
| <b>Valid SLM received</b>    | If the interface is attached to a responder MEP for a ETH-SLM session: Number of valid SLM PDUs transmitted from the source MEP to the remote or destination MEP.                                                    |
| <b>Invalid SLM received</b>  | If the interface is attached to a responder MEP for a ETH-SLM session: Number of invalid SLM PDUs transmitted from the source MEP to the remote or destination MEP.                                                  |
| <b>SLR sent</b>              | If the interface is attached to a responder MEP for a ETH-SLM session: Number detail extensive of synthetic loss reply (SLR) frames sent.                                                                            |
| <b>Valid SLR received</b>    | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of valid SLR PDUs that the source MEP received from the remote or destination MEP.                                                    |
| <b>Invalid SLR received</b>  | If the interface is attached to an initiator MEP for a ETH-SLM session: Number of invalid SLR PDUs that the source MEP received from the remote or destination MEP.                                                  |
| <b>Remote MEP identifier</b> | MEP identifier of the remote MEP.                                                                                                                                                                                    |
| <b>State (remote MEP)</b>    | State of the remote MEP: <b>idle</b> , <b>start</b> , <b>ok</b> , or <b>failed</b> .                                                                                                                                 |
| <b>MAC address</b>           | MAC address of the remote MEP.                                                                                                                                                                                       |
| <b>Type</b>                  | Whether the remote MEP MAC address was learned using automatic discovery or configured.                                                                                                                              |
| <b>Interface</b>             | Interface of the remote MEP. A seven-digit number is appended if CFM is configured to run on a routing instance of type VPLS.                                                                                        |

Table 127: show oam ethernet connectivity-fault-management mep-database Output Fields (*continued*)

| Field Name               | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Last flapped             | Date, time, and how long ago the remote MEP interface went from down to up. The format is <b>Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago)</b> . For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).                                                                                                                                                                                                                                                                                       |
| Remote defect indication | Whether the remote defect indication (RDI) bit is set in messages that have been received or transmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Port status TLV          | <ul style="list-style-type: none"> <li>In the Maintenance domain section, displays the last transmitted port status TLV value.</li> <li>In the Remote MEP section, displays the last value of port status TLV received from the remote MEP.</li> </ul> <p>In the Action profile section, displays, the last occurred event <b>port-status-tlv blocked</b> event. This event occurred due to the reception of <b>blocked</b> value in the port status TLV from remote MEP.</p>                                                                       |
| Interface status TLV     | <ul style="list-style-type: none"> <li>In the Maintenance domain section, displays the last transmitted interface status TLV value.</li> <li>In the Remote MEP section, displays the last value of interface status TLV received from the remote MEP.</li> </ul> <p>In the Action profile section, if displays, the last occurred event interface-status-tlv event ( either <b>lower-layer-down</b> or <b>down</b>). This event occurred due to the reception of either lower or <b>down</b> value in the interface status TLV from remote MEP.</p> |
| Action profile           | Name of the action profile occurrence associated with a remote MEP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Last event               | When an action profile occurs, displays the last event that triggered it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Last event cleared       | When all the configured and occurred events (under action profile) are cleared, then the action taken gets reverted (such as down interface is made up) and the corresponding time is noted and displayed.                                                                                                                                                                                                                                                                                                                                          |
| Action                   | Action taken and the corresponding time of the action occurrence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## Sample Output

### show oam ethernet connectivity-fault-management mep-database

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain vpls-vlan2000 maintenance-association vpls-vlan200
Maintenance domain name: vpls-vlan2000, Format: string, Level: 5
Maintenance association name: vpls-vlan200, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 200, Direction: up, MAC address: 00:19:e2:b0:74:01
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no Interface name: ge-0/0/1.0, Interface status:
Active, Link status: Up
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                        : no
Statistics:

```

```

CCMs sent : 1476
CCMs received out of sequence : 0
LBMs sent : 85
Valid in-order LBRs received : 78
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 1
LTMs received : 0
LTRs sent : 0
LTRs received : 1
Sequence number of next LTM request : 1
IDMs sent : 0
Valid IDMs received : 0
Invalid IDMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0
Remote MEP count: 1
Identifier   MAC address      State   Interface
100         00:19:e2:b2:81:4b    ok     vt-0/1/10.1049088

```

#### show oam ethernet connectivity-fault- management mep-database (One-Way ETH-DM)

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-domain ma6
Maintenance domain name: md6, Format: string, Level: 6
Maintenance association name: ma6, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 101, Direction: down, MAC address: 00:90:69:0a:48:57
Auto-discovery: enabled, Priority: 0
Interface name: ge-0/2/5.0, Interface status: Active, Link status: Up
Defects:
Remote MEP not receiving CCM : no
Erroneous CCM received : no
Cross-connect CCM received : no
RDI sent by some MEP : no
Statistics:
CCMs sent : 1590
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
IDMs sent : 10
Valid IDMs received : 0
Invalid IDMs received : 0
DMMs sent : 0
DMRs sent : 0
Valid DMRs received : 0
Invalid DMRs received : 0
Remote MEP count: 1

```



| Identifier | MAC address       | State | Interface  |
|------------|-------------------|-------|------------|
| 201        | 00:90:69:0a:43:94 | ok    | ge-0/2/5.0 |

### show oam ethernet connectivity-fault-management mep-database local-mep remote-mep

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain vpls-vlan2000 maintenance-association vpls-vlan200 local-mep 200
remote-mep 100
Maintenance domain name: vpls-vlan2000, Format: string, Level: 5
Maintenance association name: vpls-vlan200, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 200, Direction: up, MAC address: 00:19:e2:b0:74:01
Auto-discovery: enabled, Priority: 0
Interface name: ge-0/0/1.0, Interface status: Active, Link status: Up

Remote MEP identifier: 100, State: ok
MAC address: 00:19:e2:b2:81:4b, Type: Learned
Interface: vt-0/1/10.1049088
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: none

```

### show oam ethernet connectivity-fault-management mep-database remote-mep (Action Profile Event)

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 remote-mep 200
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 100, Direction: down, MAC address: 00:05:85:73:e8:ad
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Interface name: ge-1/0/8.0, Interface status: Active, Link status: Up

Remote MEP identifier: 200, State: ok
MAC address: 00:05:85:73:96:1f, Type: Configured
Interface: ge-1/0/8.0
Last flapped: Never
Remote defect indication: false
Port status TLV: none
Interface status TLV: lower-layer-down
Action profile: juniper
  Last event: Interface-status-tlv lower-layer-down
  Action: Interface-down, Time: 2009-03-27 14:25:10 PDT (00:00:02 ago)

```

### show oam ethernet connectivity-fault-management mep-database (Connection Protection TLV Configured)

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5

```

If connection-protection is not enabled on down MEPs, but connection-protection TLV is used, MX always sets the protection-in-use flag in connection-protection tlv, while CCMs are sent out. During reversion, this is an indicator to the receiver that protect-path is in use, otherwise the peer (receiver) assumes working is active and reversion does not work as expected. Setting this bit does not affect protection-switching/traffic-loss.

```

Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 1, Direction: down, MAC address: 00:19:e2:b1:14:30
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: yes
  Prefer me: no, Protection in use: no, FRR Flag: no
Interface name: xe-6/2/0.0, Interface status: Active, Link status: Up
Defects:
  Remote MEP not receiving CCM                : no
  Erroneous CCM received                      : no
  Cross-connect CCM received                  : no
  RDI sent by some MEP                       : no
  Some remote MEP's MAC in error state        : no
Statistics:
  CCMs sent                                  : 251
  CCMs received out of sequence               : 0
  LBMs sent                                  : 0
  Valid in-order LBRs received                : 0
  Valid out-of-order LBRs received            : 0
  LBRs received with corrupted data           : 0
  LBRs sent                                  : 0
  LTMs sent                                  : 0
  LTMs received                              : 0
  LTRs sent                                  : 0
  LTRs received                              : 0
  Sequence number of next LTM request         : 0
  1DMs sent                                  : 0
  Valid 1DMs received                        : 0
  Invalid 1DMs received                      : 0
  Out of sync 1DMs received                  : 0
  DMMs sent                                  : 0
  Valid DMMs received                       : 0
  Invalid DMMs received                     : 0
  DMRs sent                                  : 0
  Valid DMRs received                       : 0
  Invalid DMRs received                     : 0
  LMMs sent                                  : 0
  Valid LMMs received                       : 0
  Invalid LMMs received                     : 0
  LMRs sent                                  : 0
  Valid LMRs received                       : 0
  Invalid LMRs received                     : 0
Remote MEP count: 1
  Identifier  MAC address      State  Interface
    2         00:90:69:7f:e4:30

```

### show oam ethernet connectivity-fault-management mep-database

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5
Maintenance association name: ma1, Format: string
Continuity-check status: enabled, Interval: 1s, Loss-threshold: 3 frames
MEP identifier: 1, Direction: down, MAC address: 00:14:f6:b6:01:fe
Auto-discovery: enabled, Priority: 0
Interface name: ge-1/0/0.0, Interface status: Active, Link status: Up

Defects:
Remote MEP not receiving CCM                : no

```

```

Erroneous CCM received           : no
Cross-connect CCM received       : no
RDI sent by some MEP            : no

Statistics:
CCMs sent                       : 328703
CCMs received out of sequence    : 0
LBMs sent                       : 85
Valid in-order LBRs received     : 78
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent                       : 0
LTMs sent                       : 0
LTMs received                   : 0
LTRs sent                       : 0
LTRs received                   : 0
Sequence number of next LTM request : 0
1DMs sent                       : 10
Valid 1DMs received             : 10
Invalid 1DMs received           : 0
DMMs sent                       : 20
DMRs sent                       : 0
Valid DMRs received             : 10
Invalid DMRs received           : 0
LMM sent                       : 10
Valid LMM received              : 20
Invalid LMM received            : 0
LMR sent                       : 20
Valid LMR received              : 10
Invalid LMR received            : 0
SLM sent                       : 10
Valid SLM received              : 20
Invalid SLM received            : 0
SLR sent                       : 20
Valid SLR received              : 10
Invalid SLR received            : 0

Remote MEP count                 : 1

Identifier    MAC address    State    Interface
  2          00:12:1e:fb:ea:7d    ok      ge-1/0/0.0

```

#### show oam ethernet connectivity-fault- management mep-database (enhanced continuity measurement)

```

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md5 maintenance-association ma5 local-mep 2001 remote-mep 1001
Maintenance domain name: md5, Format: string, Level: 5
Maintenance association name: ma5, Format: string
Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3 frames
MEP identifier: 2001, Direction: down, MAC address: 00:19:e2:b2:81:4a
Auto-discovery: enabled, Priority: 0
Interface status TLV: up, Port status TLV: up
Interface name: ge-2/0/0.0, Interface status: Active, Link status: Up

Remote MEP identifier: 1001, State: ok
MAC address   : 00:19:e2:b0:74:00, Type: Learned
Interface     : ge-2/0/0.0
Last flapped  : Never
+ Continuity  : 91%, Admin-enable duration: 2100sec, Oper-down duration: 100sec
Remote defect indication: false

```

Port status TLV: none  
Interface status TLV: none

## show oam ethernet connectivity-fault-management mep-statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show oam ethernet connectivity-fault-management mep-statistics maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> &lt;mep <i>mep-id</i>&gt; &lt;remote-mep <i>remote-mep-id</i>&gt; &lt;count <i>entry-count</i>&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | <p>Command introduced in Junos OS Release 9.5.</p> <p>Command introduced in Junos OS Release 11.4 for EX Series switches.</p> <p>Support for ITU-T Y.1731 Ethernet synthetic frame loss measurement (ETH-SLM) added in Junos OS Release 13.2 for MX Series routers.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description</b>              | <p>On MX Series and ACX Series routers and EX Series switches with Ethernet interfaces, display ETH-DM statistics and ETH-DM frame counts.</p> <p>For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Options</b>                  | <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing CFM maintenance domain.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association.</p> <p><b>mep <i>mep-id</i></b>—(Optional) Numeric identifier of the local MEP. The range of values is 1 through 8192. On EX Series switches, the range of values is 1 through 8191.</p> <p><b>remote-mep <i>remote-mep-id</i></b>—(Optional) Numeric identifier of the remote MEP. The range of values is 1 through 8192. On EX Series switches, the range of values is 1 through 8191.</p> <p><b>count <i>entry-count</i></b>—(Optional) Number of entries to display from the statistics table. The range of values is 1 through 100. The default value is 100 entries.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management delay-statistics on page 1716</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management interfaces on page 1724</a></li> <li>• <a href="#">show oam ethernet connectivity-fault-management mep-database on page 1742</a></li> </ul>                                                                                                                                                                                                                                                                                                                |
| <b>List of Sample Output</b>    | <p><a href="#">show oam ethernet connectivity-fault-management mep-statistics (CIR counters only) on page 1755</a></p> <p><a href="#">show oam ethernet connectivity-fault-management mep-statistics (CIR and EIR counters enabled) on page 1757</a></p> <p><a href="#">show oam ethernet connectivity-fault-management mep-statistics remote-mep (CIR counters only) on page 1758</a></p>                                                                                                                                                                                                                                                                                                                                                                                   |

[show oam ethernet connectivity-fault-management mep-statistics remote-mep \(CIR and EIR counters enabled\) on page 1759](#)

[show oam ethernet connectivity-fault-management mep-statistics on page 1761](#)

[show oam ethernet connectivity-fault-management mep-statistics](#)

[remote-mep on page 1762](#)

**Output Fields** [Table 128 on page 1754](#) lists the output fields for the **show oam ethernet connectivity-fault-management mep-statistics** command. Output fields are listed in the approximate order in which they appear.

**Table 128: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields**

| Output Field Name               | Field Description                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEP identifier                  | Maintenance association end point (MEP) numeric identifier.                                                                                                                                                                                                                                                        |
| MAC address                     | Unicast MAC address configured for the MEP.                                                                                                                                                                                                                                                                        |
| Remote MEP count                | Number of remote MEPs (unless you specify the <b>remote-mep</b> option).                                                                                                                                                                                                                                           |
| Remote MEP identifier           | Numeric identifier of the remote MEP.                                                                                                                                                                                                                                                                              |
| Remote MAC address              | Unicast MAC address of the remote MEP.                                                                                                                                                                                                                                                                             |
| Index                           | Index number that corresponds to the ETH-DM entry in the CFM database.                                                                                                                                                                                                                                             |
| One-way delay (usec)            | For a one-way ETH-DM session, the frame delay time, in microseconds, measured at the receiver MEP.<br><br>For a detailed description of one-way Ethernet frame delay measurement, see the <i>ITU-T Y.1731 Ethernet Service OAM</i> topics in the <i>Junos OS Network Interfaces Library for Routing Devices</i> .  |
| Two-way delay (usec)            | For a two-way ETH-DM session, the frame delay time, in microseconds, measured at the initiator MEP.<br><br>For a detailed description of two-way Ethernet frame delay measurement, see the <i>ITU-T Y.1731 Ethernet Service OAM</i> topics in the <i>Junos OS Network Interfaces Library for Routing Devices</i> . |
| Average one-way delay           | Average one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                          |
| Average one-way delay variation | Average one-way “frame jitter” for the statistics displayed.                                                                                                                                                                                                                                                       |
| Best-case one-way delay         | Lowest one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                           |
| Worst-case one-way delay        | Highest one-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                          |
| Average two-way delay           | Average two-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                          |
| Average two-way delay variation | Average two-way “frame jitter” for the statistics displayed.                                                                                                                                                                                                                                                       |

**Table 128: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields (*continued*)**

| Output Field Name                        | Field Description                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Best-case two-way delay</b>           | Lowest two-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                          |
| <b>Worst-case two-way delay</b>          | Highest two-way frame delay calculated in this session.                                                                                                                                                                                                                                                                           |
| <b>SLM packets sent</b>                  | Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.                                                                                                                                                                                                   |
| <b>SLM packets received</b>              | Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.                                                                                                                                                                                             |
| <b>SLR packets sent</b>                  | Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.                                                                                                                                                                                                 |
| <b>SLR packets received</b>              | Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.                                                                                                                                                                                           |
| <b>Local TXFC1 value</b>                 | Number of synthetic frames transmitted to the peer MEP for a test ID. A test ID is used to distinguish each synthetic loss measurement because multiple measurements can be simultaneously activated also on a given CoS and MEP pair. It must be unique at least within the context of any SLM for the MEG and initiating MEP.   |
| <b>Local RXFC1 value</b>                 | Number of synthetic frames received from the peer MEP for a test ID. The MEP generates a unique Test ID for the session, adds the source MEP ID, and initializes the local counters for the session before SLM initiation. For each SLM PDU transmitted for the session (test ID), the local counter TXFC1 is sent in the packet. |
| <b>Last Received SLR frame TXFCf(tc)</b> | Value of the local counter TxFC1 at the time of SLM frame transmission.                                                                                                                                                                                                                                                           |
| <b>Last Received SLR frame TXFCb(t)</b>  | Value of the local counter RxFC1 at the time of SLR frame transmission.                                                                                                                                                                                                                                                           |
| <b>Frame loss (near-end)</b>             | Count of frame loss associated with ingress data frames.                                                                                                                                                                                                                                                                          |
| <b>Frame loss (far-end)</b>              | Count of frame loss associated with egress data frames.                                                                                                                                                                                                                                                                           |

## Sample Output

**show oam ethernet connectivity-fault-management mep-statistics (CIR counters only)**

```

user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma-1 local-mep 3 remote-mep 103 count 3
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
Remote MEP count                : 1
CCMs sent                       : 6550
CCMs received out of sequence   : 0
LBMs sent                       : 0
Valid in-order LBRs received    : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0

```

```

LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
1DMs sent : 5
Valid 1DMs received : 0
Invalid 1DMs received : 0
DMMs sent : 5
DMRs sent : 0
Valid DMRs received : 5
Invalid DMRs received : 0
LMM sent : 5
Valid LMM received : 5
Invalid LMM received : 0
LMR sent : 0
Valid LMR received : 5
Invalid LMR received : 0
Remote MEP identifier : 101
Remote MAC address : 00:05:85:73:39:4a

```

#### Delay measurement statistics:

| Index | One-way delay<br>(usec) | Two-way delay<br>(usec) |
|-------|-------------------------|-------------------------|
| 1     | 259                     | 519                     |
| 2     | 273                     | 550                     |
| 3     | 287                     | 571                     |
| 4     | 299                     | 610                     |
| 5     | 313                     | 650                     |

```

Average one-way delay : 286 usec
Average one-way delay variation : 62 usec
Best case one-way delay : 259 usec
Average two-way delay : 580 usec
Average two-way delay variation : 26 usec
Best case two-way delay : 519 usec
Worst case two-way delay : 650 usec

```

#### Loss measurement statistics:

| Index | Near-end<br>Frame loss<br>(CIR) | Far-end<br>Frame loss<br>(CIR) | Near-end<br>Frame loss<br>(EIR) | Far-end<br>Frame loss<br>(EIR) |
|-------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| 1     | 9                               | 9                              |                                 |                                |
| 2     | 3                               | 5                              |                                 |                                |
| 3     | 7                               | 5                              |                                 |                                |
| 4     | 9                               | 6                              |                                 |                                |
| 5     | 3                               | 6                              |                                 |                                |

```

Average near-end loss (CIR) : 6.2
Average near-end loss ratio (CIR) : 6.2%
Average far-end loss (CIR) : 6.2
Average far-end loss ratio (CIR) : 6.2%
Near-end best case loss (CIR) : 3
Near-end best case loss ratio (CIR) : 3%
Near-end worst case loss (CIR) : 9
Near-end worst case loss ratio (CIR) : 9%
Far-end best case loss (CIR) : 5
Far-end best case loss ratio (CIR) : 5%
Far-end worst case loss (CIR) : 9
Far-end worst case loss ratio (CIR) : 9%

```



### show oam ethernet connectivity-fault-management mep-statistics (CIR and EIR counters enabled)

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma-1 local-mep 3 remote-mep 103 count 3
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
```

```
Remote MEP count           : 1
CCMs sent                  : 6550
CCMs received out of sequence : 0
LBMs sent                  : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent                  : 0
LTMs sent                  : 0
LTMs received              : 0
LTRs sent                  : 0
LTRs received              : 0
Sequence number of next LTM request : 0
IDMs sent                  : 5
Valid IDMs received        : 0
Invalid IDMs received      : 0
DMMs sent                  : 5
DMRs sent                  : 0
Valid DMRs received        : 5
Invalid DMRs received      : 0
LMM sent                   : 5
Valid LMM received         : 5
Invalid LMM received       : 0
LMR sent                   : 0
Valid LMR received         : 5
Invalid LMR received       : 0
Remote MEP identifier       : 101
Remote MAC address         : 00:05:85:73:39:4a
```

#### Delay measurement statistics:

| Index | One-way delay<br>(usec) | Two-way delay<br>(usec) |
|-------|-------------------------|-------------------------|
| 1     | 259                     | 519                     |
| 2     | 273                     | 550                     |
| 3     | 287                     | 571                     |
| 4     | 299                     | 610                     |
| 5     | 313                     | 650                     |

```
Average one-way delay           : 286 usec
Average one-way delay variation  : 62 usec
Best case one-way delay         : 259 usec
Average two-way delay           : 580 usec
Average two-way delay variation  : 26 usec
Best case two-way delay         : 519 usec
Worst case two-way delay        : 650 usec
```

#### Loss measurement statistics:

| Index | Near-end<br>Frame loss<br>(CIR) | Far-end<br>Frame loss<br>(CIR) | Near-end<br>Frame loss<br>(EIR) | Far-end<br>Frame loss<br>(EIR) |
|-------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| 1     | 9                               | 9                              | 2                               | 4                              |
| 2     | 3                               | 5                              | 4                               | 6                              |
| 3     | 7                               | 5                              | 0                               | 2                              |
| 4     | 9                               | 6                              | 8                               | 2                              |
| 5     | 3                               | 6                              | 6                               | 4                              |

|                                      |        |
|--------------------------------------|--------|
| Average near-end loss (CIR)          | : 6.2  |
| Average near-end loss ratio (CIR)    | : 6.2% |
| Average far-end loss (CIR)           | : 6.2  |
| Average far-end loss ratio (CIR)     | : 6.2% |
| Near-end best case loss (CIR)        | : 3    |
| Near-end best case loss ratio (CIR)  | : 3%   |
| Near-end worst case loss (CIR)       | : 9    |
| Near-end worst case loss ratio (CIR) | : 9%   |
| Far-end best case loss (CIR)         | : 5    |
| Far-end best case loss ratio (CIR)   | : 5%   |
| Far-end worst case loss (CIR)        | : 9    |
| Far-end worst case loss ratio (CIR)  | : 9%   |
| Average near-end loss (EIR)          | : 4    |
| Average near-end loss ratio (EIR)    | : 4%   |
| Average far-end loss (EIR)           | : 3.4  |
| Average far-end loss ratio (EIR)     | : 3.4% |
| Near-end best case loss (EIR)        | : 0    |
| Near-end best case loss ratio (EIR)  | : 0%   |
| Near-end worst case loss (EIR)       | : 8    |
| Near-end worst case loss ratio (EIR) | : 8%   |
| Far-end best case loss (EIR)         | : 2    |
| Far-end best case loss ratio (EIR)   | : 2%   |
| Far-end worst case loss (EIR)        | : 6    |
| Far-end worst case loss ratio (EIR)  | : 6%   |

#### show oam ethernet connectivity-fault-management mep-statistics remote-mep (CIR counters only)

```

user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma-1 local-mep 3 remote-mep 103 count 3
remote-mep 101
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
CCMs sent : 7762
CCMs received out of sequence : 0
LBMs sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTMs sent : 0
LTMs received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
IDMs sent : 5
Valid IDMs received : 0
Invalid IDMs received : 0
DMMs sent : 5
DMRs sent : 0
Valid DMRs received : 5
Invalid DMRs received : 0
LMM sent : 5
Valid LMM received : 5
Invalid LMM received : 0
LMR sent : 0
Valid LMR received : 5
Invalid LMR received : 0
Remote MEP identifier : 101
Remote MAC address : 00:05:85:73:39:4a

```

## Delay measurement statistics:

| Index | One-way delay<br>(usec) | Two-way delay<br>(usec) |
|-------|-------------------------|-------------------------|
| 1     | 259                     | 519                     |
| 2     | 273                     | 550                     |
| 3     | 287                     | 571                     |
| 4     | 299                     | 610                     |
| 5     | 313                     | 650                     |

Average one-way delay : 286 usec  
 Average one-way delay variation : 62 usec  
 Best case one-way delay : 259 usec  
 Average two-way delay : 580 usec  
 Average two-way delay variation : 26 usec  
 Best case two-way delay : 519 usec  
 Worst case two-way delay : 650 usec

## Loss measurement statistics:

| Index | Near-end<br>Frame loss<br>(CIR) | Far-end<br>Frame loss<br>(CIR) | Near-end<br>Frame loss<br>(EIR) | Far-end<br>Frame loss<br>(EIR) |
|-------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| 1     | 9                               | 9                              |                                 |                                |
| 2     | 3                               | 5                              |                                 |                                |
| 3     | 7                               | 5                              |                                 |                                |
| 4     | 9                               | 6                              |                                 |                                |
| 5     | 3                               | 6                              |                                 |                                |

Average near-end loss (CIR) : 6.2  
 Average near-end loss ratio (CIR) : 6.2%  
 Average far-end loss (CIR) : 6.2  
 Average far-end loss ratio (CIR) : 6.2%  
 Near-end best case loss (CIR) : 3  
 Near-end best case loss ratio (CIR) : 3%  
 Near-end worst case loss (CIR) : 9  
 Near-end worst case loss ratio (CIR) : 9%  
 Far-end best case loss (CIR) : 5  
 Far-end best case loss ratio (CIR) : 5%  
 Far-end worst case loss (CIR) : 9  
 Far-end worst case loss ratio (CIR) : 9%  
 Average near-end loss (EIR) : 4  
 Average near-end loss ratio (EIR) : 4%  
 Average far-end loss (EIR) : 3.4  
 Average far-end loss ratio (EIR) : 3.4%  
 Near-end best case loss (EIR) : 0  
 Near-end best case loss ratio (EIR) : 0%  
 Near-end worst case loss (EIR) : 8  
 Near-end worst case loss ratio (EIR) : 8%  
 Far-end best case loss (EIR) : 2  
 Far-end best case loss ratio (EIR) : 2%  
 Far-end worst case loss (EIR) : 6  
 Far-end worst case loss ratio (EIR) : 6%

### show oam ethernet connectivity-fault-management mep-statistics remote-mep (CIR and EIR counters enabled)

```

user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma-1 local-mep 3 remote-mep 103 count 3
remote-mep 101
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
CCMs sent : 7762
CCMs received out of sequence : 0
LBMs sent : 0
  
```

```

Valid in-order LBRs received      : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent                        : 0
LTMs sent                       : 0
LTMs received                   : 0
LTRs sent                      : 0
LTRs received                   : 0
Sequence number of next LTM request : 0
1DMs sent                      : 5
Valid 1DMs received             : 0
Invalid 1DMs received           : 0
DMMs sent                      : 5
DMRs sent                      : 0
Valid DMRs received             : 5
Invalid DMRs received           : 0
LMM sent                       : 5
Valid LMM received              : 5
Invalid LMM received            : 0
LMR sent                       : 0
Valid LMR received              : 5
Invalid LMR received            : 0
Remote MEP identifier           : 101
Remote MAC address              : 00:05:85:73:39:4a

```

## Delay measurement statistics:

| Index | One-way delay<br>(usec) | Two-way delay<br>(usec) |
|-------|-------------------------|-------------------------|
| 1     | 259                     | 519                     |
| 2     | 273                     | 550                     |
| 3     | 287                     | 571                     |
| 4     | 299                     | 610                     |
| 5     | 313                     | 650                     |

```

Average one-way delay      : 286 usec
Average one-way delay variation : 62 usec
Best case one-way delay    : 259 usec
Average two-way delay      : 580 usec
Average two-way delay variation : 26 usec
Best case two-way delay    : 519 usec
Worst case two-way delay   : 650 usec

```

## Loss measurement statistics:

| Index | Near-end<br>Frame loss<br>(CIR) | Far-end<br>Frame loss<br>(CIR) | Near-end<br>Frame loss<br>(EIR) | Far-end<br>Frame loss<br>(EIR) |
|-------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| 1     | 10                              | 8                              | 5                               | 12                             |
| 2     | 12                              | 7                              | 6                               | 16                             |
| 3     | 7                               | 5                              | 0                               | 2                              |
| 4     | 9                               | 6                              | 8                               | 2                              |
| 5     | 3                               | 6                              | 6                               | 4                              |

```

Average near-end loss (CIR)      : 6.2
Average near-end loss ratio (CIR) : 6.2%
Average far-end loss (CIR)       : 6.2
Average far-end loss ratio (CIR) : 6.2%
Near-end best case loss (CIR)    : 3
Near-end best case loss ratio (CIR) : 3%
Near-end worst case loss (CIR)   : 9
Near-end worst case loss ratio (CIR) : 9%
Far-end best case loss (CIR)     : 5

```

```

Far-end best case loss ratio (CIR)      : 5%
Far-end worst case loss (CIR)          : 9
Far-end worst case loss ratio (CIR)     : 9%
Average near-end loss (EIR)            : 4
Average near-end loss ratio (EIR)       : 4%
Average far-end loss (EIR)              : 3.4
Average far-end loss ratio (EIR)        : 3.4%
Near-end best case loss (EIR)           : 0
Near-end best case loss ratio (EIR)     : 0%
Near-end worst case loss (EIR)          : 8
Near-end worst case loss ratio (EIR)    : 8%
Far-end best case loss (EIR)            : 2
Far-end best case loss ratio (EIR)      : 2%
Far-end worst case loss (EIR)           : 6
Far-end worst case loss ratio (EIR)     : 6%

```

### show oam ethernet connectivity-fault-management mep-statistics

```

user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma-1

```

```

MEP identifier: 100, MAC address: 00:05:85:73:7b:39

```

```

Remote MEP count: 1

```

```

CCMs sent                               : 6550
CCMs received out of sequence           : 0
LBMs sent                               : 0
Valid in-order LBRs received            : 0
Valid out-of-order LBRs received        : 0
LBRs received with corrupted data       : 0
LBRs sent                               : 0
LTMs sent                               : 0
LTMs received                           : 0
LTRs sent                               : 0
LTRs received                           : 0
Sequence number of next LTM request     : 0
1DMs sent                               : 5
Valid 1DMs received                     : 0
Invalid 1DMs received                   : 0
DMMs sent                               : 5
DMRs sent                               : 0
Valid DMRs received                     : 5
Invalid DMRs received                   : 0
SLM sent                                : 10
Valid SLM received                      : 20
Invalid SLM received                    : 0
SLR sent                                : 20
Valid SLR received                      : 10
Invalid SLR received                    : 0

```

```

Remote MEP identifier: 101

```

```

Remote MAC address: 00:05:85:73:39:4a

```

```

Delay measurement statistics:

```

| Index | One-way delay<br>(usec) | Two-way delay<br>(usec) |
|-------|-------------------------|-------------------------|
| 1     | 259                     | 519                     |
| 2     | 273                     | 550                     |
| 3     | 287                     | 571                     |
| 4     | 299                     | 610                     |
| 5     | 313                     | 650                     |

```

Average one-way delay                : 286 usec

```

```

Average one-way delay variation: 62 usec

```

```

Best case one-way delay      : 259 usec
Worst case one-way delay    : 313 usec
Average two-way delay       : 580 usec
Average two-way delay variation: 26 usec
Best case two-way delay     : 519 usec
Worst case two-way delay    : 650 usec
Synthetic Loss measurement
statistics:
  SLM packets sent          : 100
  SLM packets received      : 0
  SLR packets sent          : 100
  SLR packets received      : 0
  Accumulated SLM statistics:
    Local TXFC1 value       : 100
    Local RXFC1 value       : 100
    Last Received SLR frame TXFCftc : 100
    Last Received SLR frame TXFCbtc : 100
  SLM Frame Loss:
    Frame Loss (far-end)    : 0 (0.00 %)
    Frame Loss (near-end)   : 0 (0.00 %)

```

#### show oam ethernet connectivity-fault-management mep-statistics remote-mep

```

user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma1 remote-mep 101
MEP identifier: 100, MAC address: 00:05:85:73:7b:39

```

```

CCMs sent                      : 7762
CCMs received out of sequence  : 0
LBMs sent                      : 0
Valid in-order LBRs received   : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent                     : 0
LTMs sent                     : 0
LTMs received                  : 0
LTRs sent                     : 0
LTRs received                  : 0
Sequence number of next LTM request : 0
1DMs sent                     : 5
Valid 1DMs received           : 0
Invalid 1DMs received          : 0
DMMs sent                     : 5
DMRs sent                     : 0
Valid DMRs received           : 5
Invalid DMRs received          : 0
SLM sent                       : 10
Valid SLM received             : 20
Invalid SLM received           : 0
SLR sent                       : 20
Valid SLR received             : 10
Invalid SLR received           : 0

```

```

Remote MEP identifier: 101
Remote MAC address: 00:05:85:73:39:4a
Delay measurement statistics:
Index  One-way delay  Two-way delay
      (usec)         (usec)
  1      259          519
  2      273          550
  3      287          571
  4      299          610

```

```

      5      313      650
Average one-way delay      : 286 usec
Average one-way delay variation: 62 usec
Best case one-way delay    : 259 usec
Worst case one-way delay   : 313 usec
Average two-way delay      : 580 usec
Average two-way delay variation: 26 usec
Best case two-way delay    : 519 usec
Worst case two-way delay   : 650 usec
Synthetic Loss measurement
statistics:
  SLM packets sent          : 100
  SLM packets received      : 0
  SLR packets sent          : 100
  SLR packets received      : 0
  Accumulated SLM statistics:
  Local TXFC1 value         : 100
  Local RXFC1 value         : 100
  Last Received SLR frame TXFCftc : 100
  Last Received SLR frame TXFCbtc : 100
  SLM Frame Loss:
  Frame Loss (far-end)      : 0 (0.00 %)
  Frame Loss (near-end)     : 0 (0.00 %)

```

## show oam ethernet connectivity-fault-management path-database

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show oam ethernet connectivity-fault-management path-database<br><host-mac-address><br><maintenance-association <i>ma-name</i> ><br><maintenance-domain <i>domain-name</i> >                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.4.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | On M7i and M10i with Enhanced CFEB (CFEB-E), M320, MX Series, ACX Series, T320, and T640 routers, display IEEE 802.lag Operation, Administration, and Management (OAM) connectivity fault management path database information for a host configured with an MEP.                                                                                                                                                                                                                        |
| <b>Options</b>                  | <p><b>host-mac-address</b>—(Optional) Display connectivity fault management path database information for a specified Ethernet host.</p> <p><b>maintenance-association <i>ma-name</i></b>—(Optional) Display connectivity fault management path database information for the specified maintenance association.</p> <p><b>maintenance-domain <i>domain-name</i></b>—(Optional) Display connectivity fault management path database information for the specified maintenance domain.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet connectivity-fault-management path-database on page 1765</a>                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Output Fields</b>            | <a href="#">Table 129 on page 1764</a> lists the output fields for the <b>show oam ethernet connectivity-fault-management path-database</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                             |

**Table 129: show oam ethernet connectivity-fault-management path-database Output Fields**

| Field Name                   | Field Description                           |
|------------------------------|---------------------------------------------|
| Linktrace to                 | MAC address of the remote MEPs in the path. |
| Interface                    | Interface identifier.                       |
| Maintenance domain name      | Maintenance domain name.                    |
| Format (Maintenance domain)  | Maintenance domain name format configured.  |
| Level                        | Maintenance domain level configured.        |
| Maintenance association name | Maintenance association name.               |



Table 129: show oam ethernet connectivity-fault-management path-database Output Fields (*continued*)

| Field Name | Field Description     |
|------------|-----------------------|
| Local Mep  | Local MEP identifier. |

### Sample Output

```
show oam ethernet  
connectivity-fault  
-management  
path-database
```

```
user@host> show oam ethernet connectivity-fault-management path-database  
maintenance-domain md1 maintenance-association ma1 00:05:85:79:39:ef  
Linktrace to 00:05:85:79:39:ef, Interface : ge-3/0/0  
Maintenance Domain: md1, Level: 7  
Maintenance Association: ma1, Local Mep: 201
```

## show oam ethernet connectivity-fault-management policer

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet connectivity-fault-management policer</b> <maintenance-domain <i>md-name</i> > <maintenance-association <i>ma-name</i> >                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | On M120, M320, MX Series, T320, and T640 routers displays connectivity-fault-management policer statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Options</b>                  | <p>This command has the following options:</p> <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing CFM maintenance domain. If this option is not specified, policer statistics are displayed for all maintenance associations for all maintenance domains.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association. If this option is not specified, policer statistics are displayed for all maintenance associations for given maintenance domain. This option cannot be specified without specifying maintenance-domain name.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear oam ethernet connectivity-fault-management policer on page 1274</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet connectivity-fault-management policer on page 1767</a><br><a href="#">show oam ethernet connectivity-fault-management policer maintenance-domain <i>md-name</i> on page 1767</a><br><a href="#">show oam ethernet connectivity-fault-management policer maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> on page 1768</a>                                                                                                                                                                                                               |
| <b>Output Fields</b>            | <a href="#">Table 130 on page 1766</a> lists the output fields for the <b>show oam ethernet connectivity-fault-management policer</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                        |

**Table 130: show oam ethernet connectivity-fault-management policer Output Fields**

| Field Name                | Field Description                                                                                                                                                                                                            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Legend for Policer</b> | <p>Describes the symbols used under the <b>Scope</b> and <b>Type</b> headings:</p> <ul style="list-style-type: none"> <li>• G - Global scope</li> <li>• S - Service scope</li> <li>• cc - Continuity check (Type)</li> </ul> |
| <b>Maintenance Domain</b> | Displays the maintenance domain name.                                                                                                                                                                                        |
| <b>Level</b>              | Displays the maintenance domain level configured.                                                                                                                                                                            |

Table 130: show oam ethernet connectivity-fault-management policer Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                                              |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maintenance association | Displays the maintenance association name.                                                                                                                                                                                                                                     |
| Policer                 | Displays the policer name.                                                                                                                                                                                                                                                     |
| Type                    | Policer type. Value <b>cc</b> means this policer is used only to police continuity check CFM messages. Value <b>other</b> means this policer is used only to police non-continuity check CFM messages. Value <b>all</b> means this policer is used to police all CFM messages. |
| Scope                   | Policer scope. Displays whether the <i>global</i> (G) policer configuration is applicable or the session (S) specific policer config is applicable.                                                                                                                            |
| Drop count              | Displays the number of packets dropped by the indicated policer.                                                                                                                                                                                                               |

## Sample Output

```
show oam ethernet
connectivity-fault
-management
policer
```

Displays the policer information for all maintenance associations and their maintenance domains.

```
show oam ethernet connectivity-fault-management policer
Legend for Policer
G - Global scope
S - Service scope
cc - Continuity check
```

```
Maintenance Domain: md1 Level: 1
Maintenance association Policer      Type      Scope Drop count
ma1                    cfm-policer1 all      G          300
ma1-2                  cfm-policer1 cc       S          259
ma1-2                  cfm-policer1 other    G          300
Maintenance Domain: md2 Level: 2
Maintenance association Policer      Type      Scope Drop count
ma2                    cfm-policer1 cc       G          300
ma2                    cfm-policer2 other    S          223
```

```
show oam ethernet
connectivity-fault
-management
policer
maintenance-domain
md-name
```

Displays the policer information for the specified maintenance domain and its maintenance associations.

```
show oam ethernet connectivity-fault-management policer maintenance-domain md1
```

Legend for Policer  
G - Global scope  
S - Service scope  
cc - Continuity check

Maintenance Domain: md1 Level: 1

| Maintenance association | Policer      | Type  | Scope | Drop count |
|-------------------------|--------------|-------|-------|------------|
| ma1                     | cfm-policer1 | all   | G     | 300        |
| ma1-2                   | cfm-policer1 | cc    | S     | 259        |
| ma1-2                   | cfm-policer1 | other | G     | 300        |

show oam ethernet  
connectivity-fault  
-management  
policer  
maintenance-domain  
md-name  
maintenance-association  
ma-name

Displays the policer information for the specified **maintenance-domain** *md-name* and **maintenance-association** *ma-name*.

```
show oam ethernet connectivity-fault-management policer maintenance-domain md5  
maintenance-association ma5
```

Legend for Policer  
G - Global scope  
S - Service scope  
cc - Continuity check

Maintenance Domain: md5 Level: 5

| Maintenance association | Policer       | Type  | Scope | Drop count |
|-------------------------|---------------|-------|-------|------------|
| ma5                     | cfm-policer   | cc    | S     | 187        |
| ma5                     | cfm-policer-2 | other | S     | 234        |

## show oam ethernet connectivity-fault-management sla-iterator-statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show oam ethernet connectivity-fault-management sla-iterator-statistics maintenance-domain <i>md-name</i> maintenance-association <i>ma-name</i> sla-iterator <i>sla-iterator</i> &lt;local-mep <i>local-mep-id</i>&gt; &lt;remote-mep <i>remote-mep-id</i>&gt;</pre>                                                                                                                                                                                                                                                                                                               |
| <b>Release Information</b>      | <p>Command introduced in Junos OS Release 11.4 for EX Series switches.</p> <p>Command introduced in Junos OS Release 9.6.</p> <p>Command introduced in Junos OS Release 12.2 for ACX Series routers.</p> <p>Command introduced in Junos OS Release 13.2 for MX Series routers (not on MPC3E Hyperion cards).</p>                                                                                                                                                                                                                                                                         |
| <b>Description</b>              | Display the Ethernet Operation, Administration, and Maintenance (OAM) service-level agreement (SLA) iterator statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | <p><b>maintenance-domain <i>md-name</i></b>—Name of an existing connectivity fault management (CFM) maintenance domain.</p> <p><b>maintenance-association <i>ma-name</i></b>—Name of an existing CFM maintenance association.</p> <p><b>sla-iterator <i>sla-iterator</i></b>— Name of the iterator profile.</p> <p><b>local-mep <i>local-mep-id</i></b>—(Optional) Numeric identifier of the local MEP. The range of values is 1 through 8191.</p> <p><b>remote-mep <i>remote-mep-id</i></b>—(Optional) Numeric identifier of the remote MEP. The range of values is 1 through 8192.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><i>Configuring an Iterator Profile on a Switch (CLI Procedure)</i></li> <li><i>clear oam ethernet connectivity-fault-management sla-iterator-statistics</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet connectivity-fault-management sla-iterator-statistics on page 1772</a><br><a href="#">show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) on page 1772</a>                                                                                                                                                                                                                                                                                                                                                         |
| <b>Output Fields</b>            | <p><a href="#">Table 131 on page 1769</a> lists the output fields for the <b>show oam ethernet connectivity-fault-management sla-iterator-statistics</b> command. Output fields are listed in the approximate order in which they appear.</p>                                                                                                                                                                                                                                                                                                                                            |

**Table 131: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields**

| Output Field Name  | Output Field Description        |
|--------------------|---------------------------------|
| Maintenance domain | Name of the maintenance domain. |

Table 131: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields (*continued*)

| Output Field Name                     | Output Field Description                                                                                     |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Level                                 | Level of the maintenance domain level configured.                                                            |
| Maintenance association               | Name of the maintenance association.                                                                         |
| Local MEP id                          | Numeric identifier of the local MEP.                                                                         |
| Remote MEP id                         | Numeric identifier of the remote MEP.                                                                        |
| Remote MAC address                    | Unicast MAC address of the remote MEP.                                                                       |
| Iterator name                         | Name of iterator.                                                                                            |
| Iterator Id                           | Numeric identifier of the iterator.                                                                          |
| Iterator cycle time                   | Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection |
| Iteration period                      | Maximum number of cycles per iteration                                                                       |
| Iterator status                       | Current status of iterator whether running or stopped.                                                       |
| Infinite iterations                   | Status of iteration as infinite or finite.                                                                   |
| Counter reset time                    | Date and time when the counter was reset.                                                                    |
| Reset reason                          | Reason to reset counter.                                                                                     |
| Delay weight                          | Calculation weight of delay.                                                                                 |
| Delay variation weight                | Calculation weight of delay variation.                                                                       |
| DMM sent                              | Delay measurement message (DMM) PDU frames sent to the peer MEP in this session.                             |
| DMM skipped for threshold hit         | Number of DMM frames sent to the peer MEP in this session skipped during threshold hit.                      |
| DMM skipped for threshold hit window  | Number of DMM frames sent to the peer MEP in this session skipped during the last threshold hit window.      |
| DMR received                          | Number of delay measurement reply (DMR) frames received.                                                     |
| DMR out of sequence                   | Total number of DMR out of sequence packets received.                                                        |
| DMR received with invalid time stamps | Total number of DMR frames received with invalid timestamps.                                                 |

**Table 131: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields (*continued*)**

| Output Field Name                                 | Output Field Description                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average two-way delay                             | Average two-way frame delay for the statistics displayed.                                                                                                                                                                                                                                                                         |
| Average two-way delay variation                   | Average two-way “frame jitter” for the statistics displayed.                                                                                                                                                                                                                                                                      |
| Average one-way forward delay variation           | Average one-way forward delay variation for the statistics displayed in microseconds.                                                                                                                                                                                                                                             |
| Average one-way backward delay variation          | Average one-way backward delay variation for the statistics displayed in microseconds.                                                                                                                                                                                                                                            |
| Weighted average two-way delay                    | Weighted average two-way delay for the statistics displayed in microseconds.                                                                                                                                                                                                                                                      |
| Weighted average two-way delay variation          | Weighted average two-way delay variation for the statistics displayed in microseconds.                                                                                                                                                                                                                                            |
| Weighted average one-way backward delay variation | Weighted average one-way backward delay variation for the statistics displayed in microseconds.                                                                                                                                                                                                                                   |
| Weighted average one-way forward delay variation  | Weighted average one-way forward delay variation for the statistics displayed in microseconds.                                                                                                                                                                                                                                    |
| SLM packets sent                                  | Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.                                                                                                                                                                                                   |
| SLM packets received                              | Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.                                                                                                                                                                                             |
| SLR packets sent                                  | Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.                                                                                                                                                                                                 |
| SLR packets received                              | Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.                                                                                                                                                                                           |
| Local TXFC1 value                                 | Number of synthetic frames transmitted to the peer MEP for a test ID. A test ID is used to distinguish each synthetic loss measurement because multiple measurements can be simultaneously activated also on a given CoS and MEP pair. It must be unique at least within the context of any SLM for the MEG and initiating MEP.   |
| Local RXFC1 value                                 | Number of synthetic frames received from the peer MEP for a test ID. The MEP generates a unique Test ID for the session, adds the source MEP ID, and initializes the local counters for the session before SLM initiation. For each SLM PDU transmitted for the session (test ID), the local counter TXFC1 is sent in the packet. |
| Last Received SLR frame TXFCf(tc)                 | Value of the local counter TxFC1 at the time of SLM frame transmission.                                                                                                                                                                                                                                                           |

Table 131: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields (*continued*)

| Output Field Name               | Output Field Description                                                |
|---------------------------------|-------------------------------------------------------------------------|
| Last Received SLR frame TXFCb(t | Value of the local counter RxFCI at the time of SLR frame transmission. |
| Frame loss (near-end)           | Count of frame loss associated with ingress data frames.                |
| Frame loss (far-end)            | Count of frame loss associated with egress data frames.                 |

## Sample Output

### show oam ethernet connectivity-fault-management sla-iterator-statistics

```

user@switch> show oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator il maintenance-domain default-1 maintenance-association ma1 local-mep 1
remote-mep 2
Iterator statistics:
Maintenance domain: md6, Level: 6
Maintenance association: ma6, Local MEP id: 1000
Remote MEP id: 103, Remote MAC address: 00:90:69:0a:43:92
Iterator name: il, Iterator Id: 1
Iterator cycle time: 10ms, Iteration period: 1 cycles
Iterator status: running, Infinite iterations: true
Counter reset time: 2010-03-19 20:42:39 PDT (2d 18:24 ago)
Reset reason: Adjacency flap

Iterator delay measurement statistics:
Delay weight: 1, Delay variation weight: 1
DMM sent : 23898520
DMM skipped for threshold hit : 11000
DMM skipped for threshold hit window : 0
DMR received : 23851165
DMR out of sequence : 1142
DMR received with invalid time stamps : 36540
Average two-way delay : 129 usec
Average two-way delay variation : 15 usec
Average one-way forward delay variation : 22 usec
Average one-way backward delay variation : 22 usec
Weighted average two-way delay : 134 usec
Weighted average two-way delay variation : 8 usec
Weighted average one-way forward delay variation : 6 usec
Weighted average one-way backward delay variation : 2 usec

```

## Sample Output

### show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers)

```

user@switch> show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md0 maintenance-association mau local-mep 4 remote-mep 3 sla-iterator
lm
Iterator statistics:
Maintenance domain: 2, Level: 2
Maintenance association: W-160432000-001, Local MEP id: 2
Remote MEP id: 1, Remote MAC address: 00:90:69:0a:43:39

```



```
Iterator name: iter1, Iterator Id: 1
Iterator cycle time: 100ms, Iteration period: 10 cycles
Iterator status: running, Infinite iterations: true
Counter reset time: 2012-09-25 02:15:31 PDT (00:00:45 ago)
Reset reason: Adjacency flap
Iterator loss measurement statistics:
  LMM sent : 444
  LMM skipped for threshold hit : 0
  LMM skipped for threshold hit window: 0
  LMR received : 444
  LMR out of sequence : 0
  LMR forwarding-class mismatch : 0
Accumulated transmit statistics:
  Near-end (CIR) : 0
  Far-end (CIR) : 0
  Near-end (EIR) : 0
  Far-end (EIR) : 0
Accumulated receive statistics:
  Near-end (CIR) : 0
  Far-end (CIR) : 0
  Near-end (EIR) : 0
  Far-end (EIR) : 0
Accumulated loss statistics:
  Near-end loss (CIR) : 0
  Near-end loss-ratio (CIR) : 0 (0.00000%)
  Far-end loss (CIR) : 0
  Far-end loss-ratio (CIR) : 0 (0.00000%)
  Near-end loss (EIR) : 0
  Near-end loss-ratio (EIR) : 0 (0.00000%)
  Far-end loss (EIR) : 0
  Far-end loss-ratio (EIR) : 0 (0.00000%)
Last loss measurement statistics:
  Near-end (CIR) : 0
  Far-end (CIR) : 0
  Near-end (EIR) : 0
  Far-end (EIR) :
```

## [show oam ethernet connectivity-fault-management synthetic-loss-statistics](#)

---

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syntax                   | <code>show oam ethernet connectivity-fault-management synthetic-loss-statistics</code><br><code>&lt;local-mep <i>local-mep-id</i>&gt;</code><br><code>maintenance-association <i>ma-name</i></code><br><code>&lt;count <i>entry-count</i>&gt;</code><br><code>maintenance-domain <i>md-name</i></code><br><code>&lt;remote-mep <i>remote-mep-id</i>&gt;</code>                                                                                                                                                                                                                                                                                                                                                                    |
| Release Information      | Command introduced in Junos OS Release 13.2 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description              | On MX Series routers with Modular Port Concentrators (MPCs) with Ethernet interfaces, display the on-demand ETH-SLM statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Options                  | <p><code>count <i>entry-count</i></code>—(Optional) Number of entries to display from the statistics table. The range of values is from 1 through 100. The default value is 100.</p> <p><code>local-mep <i>local-mep-id</i></code>—(Optional) Numeric identifier of the local MEP. The range of values is from 1 through 8192.</p> <p><code>maintenance-association <i>ma-name</i></code>—Name of an existing CFM maintenance association.</p> <p><code>maintenance-domain <i>md-name</i></code>—Name of an existing connectivity fault management (CFM) maintenance domain.</p> <p><code>remote-mep <i>remote-mep-id</i></code>—(Optional) Numeric identifier of the remote MEP. The range of values is from 1 through 8192.</p> |
| Required Privilege Level | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Related Documentation    | <ul style="list-style-type: none"><li>• <a href="#">clear oam ethernet connectivity-fault-management statistics on page 1275</a></li><li>• <a href="#">clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1276</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management interfaces on page 1724</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management mep-database on page 1742</a></li><li>• <a href="#">show oam ethernet connectivity-fault-management mep-statistics on page 1753</a></li></ul>                                                                                                                                                         |
| List of Sample Output    | <a href="#">show oam ethernet connectivity-fault-management synthetic-loss-statistics on page 1775</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Output Fields            | <a href="#">Table 132 on page 1775</a> lists the output fields for the <code>show oam ethernet connectivity-fault-management synthetic-loss-statistics</code> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Table 132: show oam ethernet connectivity-fault-management synthetic-loss-statistics Output Fields

| Output Field Name                 | Field Description                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEP identifier                    | Maintenance association end point (MEP) numeric identifier.                                                                                                                                                                                                                                                                       |
| MAC address                       | Unicast MAC address configured for the MEP.                                                                                                                                                                                                                                                                                       |
| Remote MEP count                  | Number of remote MEPs (unless you specify the <b>remote-mep</b> option).                                                                                                                                                                                                                                                          |
| Remote MEP identifier             | Numeric identifier of the remote MEP.                                                                                                                                                                                                                                                                                             |
| Remote MAC address                | Unicast MAC address of the remote MEP.                                                                                                                                                                                                                                                                                            |
| SLM packets sent                  | Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.                                                                                                                                                                                                   |
| SLM packets received              | Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.                                                                                                                                                                                             |
| SLR packets sent                  | Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.                                                                                                                                                                                                 |
| SLR packets received              | Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.                                                                                                                                                                                           |
| Local TXFC1 value                 | Number of synthetic frames transmitted to the peer MEP for a test ID. A test ID is used to distinguish each synthetic loss measurement because multiple measurements can be simultaneously activated also on a given CoS and MEP pair. It must be unique at least within the context of any SLM for the MEG and initiating MEP.   |
| Local RXFC1 value                 | Number of synthetic frames received from the peer MEP for a test ID. The MEP generates a unique Test ID for the session, adds the source MEP ID, and initializes the local counters for the session before SLM initiation. For each SLM PDU transmitted for the session (test ID), the local counter TxFC1 is sent in the packet. |
| Last Received SLR frame TXFCf(tc) | Value of the local counter TxFC1 at the time of SLM frame transmission.                                                                                                                                                                                                                                                           |
| Last Received SLR frame TXFCb(t)  | Value of the local counter RxFC1 at the time of SLR frame transmission.                                                                                                                                                                                                                                                           |
| Frame loss (near-end)             | Count of frame loss associated with ingress data frames.                                                                                                                                                                                                                                                                          |
| Frame loss (far-end)              | Count of frame loss associated with egress data frames.                                                                                                                                                                                                                                                                           |

## Sample Output

```
show oam ethernet connectivity-fault-
management
```

### synthetic-loss-statistics

```
user@switch> show oam ethernet connectivity-fault-management synthetic-loss-statistics
maintenance-domain md6 maintenance-association ma6
MEP identifier: 100, MAC address: 00:05:85:73:7b:39
Remote MEP count: 2
  Remote MEP identifier: 101
  Remote MAC address: 00:05:85:73:39:4a
Synthetic Loss measurement statistics:
  SLM packets sent                : 100
  SLM packets received            : 0
  SLR packets sent                : 100
  SLR packets received            : 0
Accumulated SLM statistics:
  Local TXFC1 value               : 100
  Local RXFC1 value               : 100
  Last Received SLR frame TXFCftc : 100
  Last Received SLR frame TXFCbtc : 100
SLM Frame Loss:
  Frame Loss (far-end)            : 0 (0.00 %)
  Frame Loss (near-end)           : 0 (0.00 %)
```

## show oam ethernet evc

|                                 |                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet evc &lt;evc-id&gt;</b>                                                                                                                                          |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.5.                                                                                                                                          |
| <b>Description</b>              | On MX Series routers with OAM Ethernet Virtual Connection (EVC) configurations, displays the EVC configuration and status information.                                               |
| <b>Options</b>                  | This command has no options.                                                                                                                                                         |
| <b>Required Privilege Level</b> | View                                                                                                                                                                                 |
| <b>Output Fields</b>            | <a href="#">Table 133 on page 1777</a> lists the output fields for the <b>show oam ethernet evc</b> command. Output fields are listed in the approximate order in which they appear. |

**Table 133: show oam ethernet evc Output Fields**

| Field Name            | Field Description                                                                               |
|-----------------------|-------------------------------------------------------------------------------------------------|
| <b>EVC identifier</b> | Header for the EVC information showing the EVC name, configuration, and active/inactive status. |
| <b>UNI count</b>      | Number of configured and active UNIs.                                                           |
| <b>Protocol</b>       | Protocol configured between the UNIs.                                                           |
| <b>Local UNIs</b>     | Heading for the list of local UNIs                                                              |
| <b>UNI Identifier</b> | Name of the UNI.                                                                                |
| <b>Interface</b>      | Interface type-dpc/pic/port.unit-number.                                                        |
| <b>Status</b>         | Status operational or not operational.                                                          |

## Sample Output

### show oam ethernet evc

```

user@host> show oam ethernet evc
EVC identifier: evc1, Point-to-Point, Active
UNI count: Configured(2), Active(2)
Protocol: cfm, Management domain: md, Management association: ma
Local UNIs:
  UNI Identifier      Interface      Status
  uni1                ge-1/1/1      Operational
  uni2                ge-1/1/1      Not Operational

```

## show oam ethernet fnp interface

|                                 |                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet fnp interface</b><br><i>&lt;ethernet-interface-name&gt;</i><br><i>&lt;routing-instance routing-instance-name&gt;</i>                                                                     |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.4.                                                                                                                                                                  |
| <b>Description</b>              | On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) information for Ethernet interfaces.                        |
| <b>Options</b>                  | <i>interface-name</i> —(Optional) Display Ethernet FNP information for the specified Ethernet interface only.<br><br><i>routing-instance-name</i> —(Optional) Display FNP for the specified routing instance. |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                          |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet fnp interface on page 1778</a>                                                                                                                                                  |
| <b>Output Fields</b>            | <a href="#">Table 134 on page 1778</a> lists the output fields for the <b>show oam ethernet fnp interface</b> command. Output fields are listed in the approximate order in which they appear.                |

**Table 134: show oam ethernet fnp interface Output Fields**

| Field Name                    | Field Description                                    |
|-------------------------------|------------------------------------------------------|
| <b>Interface</b>              | Name of the interface for the displayed information. |
| <b>VLAN</b>                   | Name of the VLAN.                                    |
| <b>State</b>                  | Displays state of the interface.                     |
| <b>FNP Message Interface</b>  | Displays the message interface type.                 |
| <b>FNP Message Source MAC</b> | Displays the source MAC address.                     |

## Sample Output

### show oam ethernet fnp interface

```

user@host> show oam ethernet fnp interface
The FNP controlled interfaces are:
Interface  VLAN  State  FNP message  FNP message
              Interface  Source MAC

ge-0/0/0.30  30    down  1si.1054976  a0:aa:aa:aa:aa:aa
ge-0/0/0.20  20    down  1si.1054976  a0:aa:aa:aa:aa:aa

```

## show oam ethernet fnp messages

|                                 |                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet fnp messages</b><br><b>&lt;interface <i>interface-name</i>&gt;</b><br><b>&lt;routing instance <i>routing-instance-name</i>&gt;</b>                                                                           |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.4                                                                                                                                                                                       |
| <b>Description</b>              | On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) messages.                                                                       |
| <b>Options</b>                  | <b><i>interface-name</i></b> —(Optional) Display Ethernet FNP messages for the specified Ethernet interface only.<br><br><b><i>routing-instance-name</i></b> —(Optional) Display FNP messages for the specified routing instance. |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                              |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet fnp messages on page 1780</a>                                                                                                                                                                       |
| <b>Output Fields</b>            | <a href="#">Table 135 on page 1779</a> lists the output fields for the <b>show oam ethernet fnp messages</b> command. Output fields are listed in the approximate order in which they appear.                                     |

**Table 135: show oam ethernet fnp messages Output Fields**

| Field Name                      | Field Description                                                                |
|---------------------------------|----------------------------------------------------------------------------------|
| Message from source MAC address | The source MAC address of the message.                                           |
| Originating port number         | Port number of the original message.                                             |
| Time since last message         | Elapsed time in hours, minutes, and seconds since the last message was received. |
| Time since last message update  | Elapsed time in hours, minutes, and seconds since the last message was updated.  |
| Total messages received         | Number of messages received.                                                     |
| Domain ID                       | Domain ID of the message.                                                        |
| STP Root ID                     | The spanning tree Root ID of the message.                                        |
| Trigger Reason                  | The reason why the message was triggered.                                        |
| Effectuated VLANs               | Number of VLANs that are affected.                                               |
| Disabled interfaces             | Name of the interfaces that are disabled.                                        |

## Sample Output

### show oam ethernet fnp messages

```
user@host> show oam ethernet fnp messages
Active FNP messages on interface lsi.1054465
Message source MAC: a0:aa:aa:aa:aa:aa
Originating port number: 141077
Time since last message: 00:00:00
Time since last message update: 00:00:00
Total messages received: 1
Domain ID: 0
STP Root ID: 0.f0:ff:ff:ff:ff:ff
Trigger reason: todo
Effectuated VLANs: 10
Disabled interfaces:
  Interface VLAN
  ge-0/0/0.10 10
```



## show oam ethernet fnp status

|                                 |                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show oam ethernet fnp status</b><br><b>&lt;interface <i>interface-name</i>&gt;</b><br><b>&lt;routing instance <i>routing-instance-name</i>&gt;</b>                                                                       |
| <b>Release Information</b>      | Command introduced in Junos OS Release 11.4                                                                                                                                                                                 |
| <b>Description</b>              | On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) status.                                                                   |
| <b>Options</b>                  | <b><i>interface-name</i></b> —(Optional) Display Ethernet FNP information for the specified Ethernet interface only.<br><br><b><i>routing-instance-name</i></b> —(Optional) Display FNP for the specified routing instance. |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                        |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet fnp status on page 1781</a>                                                                                                                                                                   |
| <b>Output Fields</b>            | <a href="#">Table 136 on page 1781</a> lists the output fields for the <b>show oam ethernet fnp status</b> command. Output fields are listed in the approximate order in which they appear.                                 |

**Table 136: show oam ethernet fnp status Output Fields**

| Field Name                    | Field Description                                                     |
|-------------------------------|-----------------------------------------------------------------------|
| <b>FNP interval</b>           | The time interval between messages.                                   |
| <b>Loss threshold</b>         | The number of messages that can be lost before FNP is marked as down. |
| <b>FNP enabled interfaces</b> | Displays interfaces that are enabled.                                 |
| <b>Interface</b>              | The name of the interface.                                            |
| <b>Domain ID</b>              | Domain ID of the message.                                             |
| <b>STP Root ID</b>            | The spanning tree Root ID of the message.                             |
| <b>FNP Messages</b>           | The total number of messages received.                                |

## Sample Output

### show oam ethernet fnp status

```

user@host> show oam ethernet status
  FNP interval:
  Loss threshold
  FNP enabled interfaces
  Interface      Domain ID      STP Root ID      FNP Messages

```

|               |     |                     |   |
|---------------|-----|---------------------|---|
| ge-0/0/0.1278 | 100 | 0.f0:ff:ff:ff:ff:ff | 0 |
|---------------|-----|---------------------|---|

## show oam ethernet link-fault-management

|                                 |                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show oam ethernet link-fault-management<br><brief   detail><br><interface-name>                                                                                                                                                                             |
| <b>Release Information</b>      | Command introduced in Junos OS Release 8.2.                                                                                                                                                                                                                 |
| <b>Description</b>              | On EX Series switches and M320, M120, MX Series, T320, and T640 routers, display Operation, Administration, and Management (OAM) link fault management information for Ethernet interfaces.                                                                 |
| <b>Options</b>                  | <b>brief   detail</b> —(Optional) Display the specified level of output.<br><br><b>interface-name</b> —(Optional) Display link fault management information for the specified Ethernet interface only.                                                      |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                        |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet link-fault-management brief on page 1787</a><br><a href="#">show oam ethernet link-fault-management brief (Loopback tracking) on page 1788</a><br><a href="#">show oam ethernet link-fault-management detail on page 1788</a> |
| <b>Output Fields</b>            | <a href="#">Table 137 on page 1783</a> lists the output fields for the <b>show oam ethernet link-fault-management</b> command. Output fields are listed in the approximate order in which they appear.                                                      |

**Table 137: show oam ethernet link-fault-management Output Fields**

| Field Name             | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Level of Output |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Status</b>          | Indicates the status of the OAM discovery state mechanism.<br><br><ul style="list-style-type: none"> <li><b>Down</b>—Discovery mechanism is not running.</li> <li><b>Running</b>—Discovery mechanism is running.</li> </ul>                                                                                                                                                                                                                                                          | All levels      |
| <b>Discovery state</b> | State of the discovery mechanism. If the status of the discovery mechanism is Down then the state of discovery mechanism is Fault. However, if the status of the discovery mechanism is Running then the state can be any one of the following:<br><br><ul style="list-style-type: none"> <li><b>Passive Wait</b></li> <li><b>Active Send Local</b></li> <li><b>Send Any</b></li> <li><b>Send Local Remote</b></li> <li><b>Send Local Remote Ok</b></li> <li><b>Fault</b></li> </ul> | All levels      |
| <b>ISSU</b>            | Specifies that the local end is undergoing a unified in-service software upgrade (ISSU).                                                                                                                                                                                                                                                                                                                                                                                             | All levels      |

Table 137: show oam ethernet link-fault-management Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Peer address              | Address of the OAM peer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | All levels      |
| Flags                     | <p>Information about the interface. Possible values are described in the “Link Flags” section under <i>Common Output Fields Description</i>.</p> <ul style="list-style-type: none"> <li>• <b>Remote-Stable</b>—Indicates remote OAM client acknowledgment of and satisfaction with local OAM state information. <b>False</b> indicates that remote DTE either has not seen or is unsatisfied with local state information. <b>True</b> indicates that remote DTE has seen and is satisfied with local state information.</li> <li>• <b>Local-Stable</b>—Indicates local OAM client acknowledgment of and satisfaction with remote OAM state information. <b>False</b> indicates that local DTE either has not seen or is unsatisfied with remote state information. <b>True</b> indicates that local DTE has seen and is satisfied with remote state information.</li> <li>• <b>Remote-State-Valid</b>—Indicates the OAM client has received remote state information found within Local Information TLVs of received Information OAM PDUs. <b>False</b> indicates that OAM client has not seen remote state information. <b>True</b> indicates that the OAM client has seen remote state information.</li> </ul>                                                                             | All levels      |
| Remote loopback status    | Indicates the remote loopback status. An OAM entity can put its remote peer into loopback mode using the Loopback control OAM PDU. In loopback mode, every frame received is transmitted back on the same port (except for OAM PDUs, which are needed to maintain the OAM session).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | All levels      |
| Remote entity information | <p>Remote entity information.</p> <ul style="list-style-type: none"> <li>• <b>Remote MUX action</b>—Indicates the state of the multiplexer functions of the OAM sublayer. Device is forwarding non-OAM PDUs to the lower sublayer or discarding non-OAM PDUs.</li> <li>• <b>Remote parser action</b>—Indicates the state of the parser function of the OAM sublayer. Device is forwarding non-OAM PDUs to higher sublayer, looping back non-OAM PDUs to the lower sublayer, or discarding non-OAM PDUs.</li> <li>• <b>Discovery mode</b>—Indicates whether discovery mode is active or inactive.</li> <li>• <b>Unidirectional mode</b>—Indicates the ability to operate a link in a unidirectional mode for diagnostic purposes.</li> <li>• <b>Remote loopback mode</b>—Indicates whether remote loopback is supported or unsupported.</li> <li>• <b>Link events</b>—Indicates whether interpreting link events is supported or unsupported on the remote peer.</li> <li>• <b>Variable requests</b>—Indicates whether variable requests are supported. The Variable Request OAM PDU, is used to request one or more MIB variables from the remote peer.</li> <li>• <b>Remote in ISSU</b>—Indicates that the remote end is undergoing a unified in-service software upgrade (ISSU).</li> </ul> | All levels      |
| Loopback Tracking         | Indicates that loopback detection is enabled or disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All levels      |
| Loop Status               | Indicates that a loopback issue is either found, not found, or unknown when loopback tracking is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | All levels      |

## OAM Receive Statistics

Table 137: show oam ethernet link-fault-management Output Fields (*continued*)

| Field Name                                         | Field Description                                                                                                                                                                  | Level of Output |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Information</b>                                 | The total number of information PDUs received.                                                                                                                                     | <b>detail</b>   |
| <b>Event</b>                                       | The total number of loopback control PDUs received.                                                                                                                                | <b>detail</b>   |
| <b>Variable request</b>                            | The total number of variable request PDUs received.                                                                                                                                | <b>detail</b>   |
| <b>Variable response</b>                           | The total number of variable response PDUs received.                                                                                                                               | <b>detail</b>   |
| <b>Loopback control</b>                            | The total number of loopback control PDUs received.                                                                                                                                | <b>detail</b>   |
| <b>Organization specific</b>                       | The total number of vendor organization specific PDUs received.                                                                                                                    | <b>detail</b>   |
| <b>OAM Transmit Statistics</b>                     |                                                                                                                                                                                    |                 |
| <b>Information</b>                                 | The total number of information PDUs transmitted.                                                                                                                                  | <b>detail</b>   |
| <b>Event</b>                                       | The total number of event notification PDUs transmitted.                                                                                                                           | <b>detail</b>   |
| <b>Variable request</b>                            | The total number of variable request PDUs transmitted.                                                                                                                             | <b>detail</b>   |
| <b>Variable response</b>                           | The total number of variable response PDUs transmitted.                                                                                                                            | <b>detail</b>   |
| <b>Loopback control</b>                            | The total number of loopback control PDUs transmitted.                                                                                                                             | <b>detail</b>   |
| <b>Organization specific</b>                       | The total number of vendor organization specific PDUs transmitted.                                                                                                                 | <b>detail</b>   |
| <b>OAM Received Symbol Error Event information</b> |                                                                                                                                                                                    |                 |
| <b>Events</b>                                      | The number of symbol error event TLVs that have been received since the OAM sublayer was reset.                                                                                    | <b>detail</b>   |
| <b>Window</b>                                      | The symbol error event window in the received PDU.<br><br>The protocol default value is the number of symbols that can be received in one second on the underlying physical layer. | <b>detail</b>   |
| <b>Threshold</b>                                   | The number of errored symbols in the period required for the event to be generated.                                                                                                | <b>detail</b>   |
| <b>Errors in period</b>                            | The number of symbol errors in the period reported in the received event PDU.                                                                                                      | <b>detail</b>   |
| <b>Total errors</b>                                | The number of errored symbols that have been reported in received event TLVs since the OAM sublayer was reset.<br><br>Symbol errors are coding symbol errors.                      | <b>detail</b>   |
| <b>OAM Received Frame Error Event Information</b>  |                                                                                                                                                                                    |                 |

Table 137: show oam ethernet link-fault-management Output Fields (*continued*)

| Field Name                                               | Field Description                                                                                                                                                                       | Level of Output |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Events</b>                                            | The number of errored frame event TLVs that have been received since the OAM sublayer was reset.                                                                                        | <b>detail</b>   |
| <b>Window</b>                                            | The duration of the window in terms of the number of 100 ms period intervals.                                                                                                           | <b>detail</b>   |
| <b>Threshold</b>                                         | The number of detected errored frames required for the event to be generated.                                                                                                           | <b>detail</b>   |
| <b>Errors in period</b>                                  | The number of detected errored frames in the period.                                                                                                                                    | <b>detail</b>   |
| <b>Total errors</b>                                      | The number of errored frames that have been reported in received event TLVs since the OAM sublayer was reset.<br><br>A frame error is any frame error on the underlying physical layer. | <b>detail</b>   |
| <b>OAM Received Frame Period Error Event Information</b> |                                                                                                                                                                                         |                 |
| <b>Events</b>                                            | The number of frame seconds errors event TLVs that have been received since the OAM sublayer was reset.                                                                                 | <b>detail</b>   |
| <b>Window</b>                                            | The duration of the frame seconds window.                                                                                                                                               | <b>detail</b>   |
| <b>Threshold</b>                                         | The number of frame seconds errors in the period.                                                                                                                                       | <b>detail</b>   |
| <b>Errors in period</b>                                  | The number of frame seconds errors in the period.                                                                                                                                       | <b>detail</b>   |
| <b>Total errors</b>                                      | The number of frame seconds errors that have been reported in received event TLVs since the OAM sublayer was reset.                                                                     | <b>detail</b>   |
| <b>OAM Transmitted Symbol Error Event Information</b>    |                                                                                                                                                                                         |                 |
| <b>Events</b>                                            | The number of symbol error event TLVs that have been transmitted since the OAM sublayer was reset.                                                                                      | <b>detail</b>   |
| <b>Window</b>                                            | The symbol error event window in the transmitted PDU.                                                                                                                                   | <b>detail</b>   |
| <b>Threshold</b>                                         | The number of errored symbols in the period required for the event to be generated.                                                                                                     | <b>detail</b>   |
| <b>Errors in period</b>                                  | The number of symbol errors in the period reported in the transmitted event PDU.                                                                                                        | <b>detail</b>   |
| <b>Total errors</b>                                      | The number of errored symbols reported in event TLVs that have been transmitted since the OAM sublayer was reset.                                                                       | <b>detail</b>   |
| <b>OAM Current Symbol Error Event Information</b>        |                                                                                                                                                                                         |                 |
| <b>Events</b>                                            | The number of symbol error TLVs that have been generated regardless of whether the threshold for sending event TLVs has been crossed.                                                   | <b>detail</b>   |
| <b>Window</b>                                            | The symbol error event window in the transmitted PDU.                                                                                                                                   | <b>detail</b>   |

Table 137: show oam ethernet link-fault-management Output Fields (*continued*)

| Field Name                                           | Field Description                                                                                                                                          | Level of Output |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Threshold</b>                                     | The number of errored symbols in the period required for the event to be generated.                                                                        | <b>detail</b>   |
| <b>Errors in period</b>                              | The total number of symbol errors in the period reported.                                                                                                  | <b>detail</b>   |
| <b>Total errors</b>                                  | The number of errored symbols reported in event TLVs that have been generated regardless of whether the threshold for sending event TLVs has been crossed. | <b>detail</b>   |
| <b>OAM Transmitted Frame Error Event Information</b> |                                                                                                                                                            |                 |
| <b>Events</b>                                        | The number of errored frame event TLVs that have been transmitted since the OAM sublayer was reset.                                                        | <b>detail</b>   |
| <b>Window</b>                                        | The duration of the window in terms of the number of 100 ms period intervals.                                                                              | <b>detail</b>   |
| <b>Threshold</b>                                     | The number of detected errored frames required for the event to be generated.                                                                              | <b>detail</b>   |
| <b>Errors in period</b>                              | The number of detected errored frames in the period.                                                                                                       | <b>detail</b>   |
| <b>Total errors</b>                                  | The number of errored frames that have been detected since the OAM sublayer was reset.                                                                     | <b>detail</b>   |
| <b>OAM Current Frame Error Event Information</b>     |                                                                                                                                                            |                 |
| <b>Events</b>                                        | The number of errored frame event TLVs that have been generated regardless of whether the threshold for sending event TLVs has been crossed.               | <b>detail</b>   |
| <b>Window</b>                                        | The duration of the window in terms of the number of 100 ms period intervals.                                                                              | <b>detail</b>   |
| <b>Threshold</b>                                     | The number of detected errored frames required for the event to be generated.                                                                              | <b>detail</b>   |
| <b>Errors in period</b>                              | The number of errored frames in the period.                                                                                                                | <b>detail</b>   |
| <b>Total errors</b>                                  | The number of errored frames detected regardless of whether the threshold for transmitting event TLVs has been crossed.                                    | <b>detail</b>   |

## Sample Output

### show oam ethernet link-fault-management brief

```

user@host> show oam ethernet link-fault-management brief
Interface: ge-3/1/3
  Status: Running, Discovery state: Send Any, ISSU
  Peer address: 00:90:69:72:2c:83
  Flags:Remote-Stable Remote-State-Valid Local-Stable 0x50 Remote loopback status:
Disabled on local port, Enabled on peer port
  Remote entity information:
    Remote MUX action: discarding, Remote parser action: loopback
    Discovery mode: active, Unidirectional mode: unsupported
    Remote loopback mode: supported, Link events: supported
    Variable requests: unsupported, Remote in ISSU

```

**show oam ethernet link-fault-management brief (Loopback tracking)**

```
user@host> show oam ethernet link-fault-management
Interface: ge-3/1/3
Status: Running, Discovery state: Active Send Local
Peer address: 00:00:00:00:00:00
Flags:0x8
Loopback tracking: Enabled,      Loop Status: Found
```

**show oam ethernet link-fault-management detail**

```
user@host> show oam ethernet link-fault-management detail
Interface: ge-6/1/0
Status: Running, Discovery state: Send Any, ISSU
Peer address: 00:90:69:0a:07:14
Flags:Remote-Stable Remote-State-Valid Local-Stable 0x50
OAM receive statistics:
  Information: 186365, Event: 0, Variable request: 0, Variable response: 0
  Loopback control: 0, Organization specific: 0
OAM transmit statistics:
  Information: 186347, Event: 0, Variable request: 0, Variable response: 0
  Loopback control: 0, Organization specific: 0
OAM received symbol error event information:
  Events: 0, Window: 0, Threshold: 0
  Errors in period: 0, Total errors: 0
OAM received frame error event information:
  Events: 0, Window: 0, Threshold: 0
  Errors in period: 0, Total errors: 0
OAM received frame period error event information:
  Events: 0, Window: 0, Threshold: 0
  Errors in period: 0, Total errors: 0
OAM transmitted symbol error event information:
  Events: 0, Window: 0, Threshold: 1
  Errors in period: 0, Total errors: 0
OAM current symbol error event information:
  Events: 0, Window: 0, Threshold: 1
  Errors in period: 0, Total errors: 0
OAM transmitted frame error event information:
  Events: 0, Window: 0, Threshold: 1
  Errors in period: 0, Total errors: 0
OAM current frame error event information:
  Events: 0, Window: 0, Threshold: 1
  Errors in period: 0, Total errors: 0
Remote entity information:
  Remote MUX action: forwarding, Remote parser action: forwarding
  Discovery mode: active, Unidirectional mode: unsupported
  Remote loopback mode: supported, Link events: supported
  Variable requests: unsupported, Remote in ISSU
```



## show oam ethernet lmi

**Syntax** `show oam ethernet lmi (interface <interface-name>)`

**Release Information** Command introduced in Junos OS Release 9.5.

**Description** On routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet, and OAM Ethernet Local Management Interface (E-LMI) configuration, display the LMI information for the configured interfaces or optionally for a specified interface.



**NOTE:** On MX Series routers, E-LMI is supported on Gigabit Ethernet (ge), 10-Gigabit Ethernet (xe), and Aggregated Ethernet (ae) interfaces configured on MX Series routers with DPC only.

**Options** `interface`—(Optional) Display LMI information for a specified interface.

`interface-name`—(Optional) Display Ethernet LMI information for the specified interface only.

**Required Privilege Level** View

**Output Fields** [Table 138 on page 1789](#) lists the output fields for the `show oam ethernet lmi` command. Output fields are listed in the approximate order in which they appear.

**Table 138: show oam ethernet lmi Output Fields**

| Field Name                 | Field Description                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Physical Interface         | Header for the EVC information showing the Ethernet virtual circuit (EVC) name, configuration, and active/inactive status. |
| UNI Identifier             | Name of the UNI.                                                                                                           |
| EVC map type               | EVC configuration.                                                                                                         |
| Polling verification timer | Polling verification timer status.                                                                                         |
| E-LMI state                | Operational status of the E-LMI configuration in the interfaces or specified interface.                                    |
| Priority/Untagged VLAN ID  | To be provided.                                                                                                            |
| Default EVC                | The EVC set as the default EVC.                                                                                            |
| Associated EVCs            | Heading for the list of configured EVCs.                                                                                   |
| EVC Identifier             | EVC name.                                                                                                                  |

Table 138: show oam ethernet lmi Output Fields (*continued*)

| Field Name   | Field Description              |
|--------------|--------------------------------|
| Reference ID | To be provided.                |
| Status       | Status active or not active.   |
| CE VLAN IDs  | Customer edge VLAN ID numbers. |

## Sample Output

### show oam ethernet lmi interface

```
user@host> show oam ethernet lmi interface ge-1/1/1
Physical interface: ge-1/1/1, Physical link is Up
UNI identifier: uni-ce1, EVC map type: Bundling
Polling verification timer: Enabled, E-LMI state: Operational
Priority/Untagged VLAN ID: 20, Default EVC: evc1
Associated EVCs:
  EVC      Reference   Status      CE VLAN IDs
  Identifier ID
  evc1      1       Active (New)  1-2048
  evc2      2       Not Active   2049-4096
```

## show oam ethernet lmi statistics

|                                 |                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show oam ethernet lmi statistics &lt;interface <i>interface-name</i>&gt;</code>                                                                                                                    |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.5.                                                                                                                                                              |
| <b>Description</b>              | On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Local Management Interface (LMI) statistics.                                               |
| <b>Options</b>                  | <p><b>interface</b>—(Optional) Display LMI statistics for a specified interface.</p> <p><b>interface-name</b>—(Optional) Display Ethernet LMI information for the specified Ethernet interface only.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                     |
| <b>List of Sample Output</b>    | <a href="#">show oam ethernet lmi statistics on page 1791</a>                                                                                                                                            |
| <b>Output Fields</b>            | <a href="#">Table 139 on page 1791</a> lists the output fields for the <b>show oam ethernet lmi statistics</b> command. Output fields are listed in the approximate order in which they appear.          |

**Table 139: show oam ethernet lmi statistics Output Fields**

| Field Name                     | Field Description                                   |
|--------------------------------|-----------------------------------------------------|
| Physical interface             | Name of the interface for the displayed statistics. |
| Reliability errors             | Number of E-LMI reliability errors logged.          |
| Protocol errors                | Number of E-LMI protocol errors.                    |
| Status check received          | Number of E-LMI status check receive errors.        |
| Status check sent              | Number of E-LMI status check sent errors.           |
| Full status received           | Number of E-LMI full status receive errors.         |
| Full status sent               | Number of E-LMI full status sent errors.            |
| Full status continued received | Number of E-LMI status continued received errors.   |
| Full status continued sent     | Number of E-LMI full status continued sent errors.  |
| Asynchronous status sent       | Number of E-LMI asynchronous status sent errors.    |

## Sample Output

### show oam ethernet lmi statistics

```
user@host> show oam ethernet lmi statistics interface ge-1/1/1
```

|                                |                              |
|--------------------------------|------------------------------|
| Physical interface: ge-1/1/1   |                              |
| Reliability errors             | 4 Protocol errors            |
| 0                              |                              |
| Status check received          | 0 Status check sent          |
| 0                              |                              |
| Full status received           | 694 Full status sent         |
| 694                            |                              |
| Full status continued received | 0 Full status continued sent |
| 0                              |                              |
| Asynchronous status sent       | 0                            |

## show pppoe interfaces

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show pppoe interfaces<br><brief   detail<br><pp0.logical>                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | Display session-specific information about PPPoE interfaces.                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b>none</b>—Display interface information for all PPPoE interfaces.</p> <p><b>brief   detail</b>—(Optional) Display the specified level of output.</p> <p><b>pp0.logical</b>—(Optional) Name of an interface. The logical unit number for static interfaces can be a value from 0 through 16385. The logical unit number for dynamic interfaces can be a value from 1073741824 through the maximum number of logical interfaces supported on your router.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><i>Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration</i></li> </ul>                                                                                                                                                                                                                                                                                                                        |
| <b>List of Sample Output</b>    | <a href="#">show pppoe interfaces on page 1795</a><br><a href="#">show pppoe interfaces (Status for the Specified Interface) on page 1795</a><br><a href="#">show pppoe interfaces brief on page 1795</a><br><a href="#">show pppoe interfaces detail on page 1796</a><br><a href="#">show pppoe interfaces (PPPoE Subscriber Interface with ACI Interface Set) on page 1796</a>                                                                                 |
| <b>Output Fields</b>            | <p><a href="#">Table 140 on page 1793</a> lists the output fields for the <b>show pppoe interfaces</b> command. Output fields are listed in the approximate order in which they appear. Not all fields are displayed for PPPoE interfaces on M120 and M320 routers in server mode.</p>                                                                                                                                                                           |

**Table 140: show pppoe interfaces Output Fields**

| Field Name               | Field Description                                                                                                                         | Level of Output              |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Logical Interface</b> |                                                                                                                                           |                              |
| <b>Logical interface</b> | Name of the logical interface.                                                                                                            | All levels                   |
| <b>Index</b>             | Index number of the logical interface, which reflects its initialization sequence.                                                        | <b>detail extensive none</b> |
| <b>State</b>             | State of the logical interface: <b>up</b> or <b>down</b> .                                                                                | All levels                   |
| <b>Session ID</b>        | Session ID.                                                                                                                               | All levels                   |
| <b>Type</b>              | Origin of the logical interface: <b>Static</b> or <b>Dynamic</b> . Indicates whether the interface was statically or dynamically created. | <b>detail extensive none</b> |

Table 140: show pppoe interfaces Output Fields (*continued*)

| Field Name                              | Field Description                                                                                                                                                                                                                                                                                                                                      | Level of Output              |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Service name</b>                     | Type of service required (can be used to indicate an ISP name or a class or quality of service).                                                                                                                                                                                                                                                       | <b>detail extensive none</b> |
| <b>Configured AC name</b>               | Configured access concentrator name.                                                                                                                                                                                                                                                                                                                   | <b>detail extensive none</b> |
| <b>Session AC name</b>                  | Name of the access concentrator.                                                                                                                                                                                                                                                                                                                       | <b>detail extensive none</b> |
| <b>Remote MAC address or Remote MAC</b> | MAC address of the remote side of the connection, either the access concentrator or the PPPoE client.                                                                                                                                                                                                                                                  | All levels                   |
| <b>Session uptime</b>                   | Length of time the session has been up, in <i>hh:mm:ss</i> .                                                                                                                                                                                                                                                                                           | <b>detail extensive none</b> |
| <b>Dynamic Profile</b>                  | Name of the dynamic profile that was used to create this interface. If the interface was statically created, this field is not displayed.                                                                                                                                                                                                              | <b>detail extensive none</b> |
| <b>Underlying interface</b>             | Interface on which PPPoE is running.                                                                                                                                                                                                                                                                                                                   | All levels                   |
| <b>Agent Circuit ID</b>                 | Agent circuit identifier (ACI) that corresponds to the DSLAM interface that initiated the client service request. An asterisk is interpreted as a wildcard character and can appear at the beginning, the end, or both the beginning and end of the string. If the agent circuit ID is not configured, this field is not displayed.                    | <b>detail extensive none</b> |
| <b>Agent Remote ID</b>                  | Agent remote identifier that corresponds to the subscriber associated with the DSLAM interface that initiated the service request. An asterisk is interpreted as a wildcard character and can appear at the beginning, the end, or both at the beginning and end of the string. If the agent remote ID is not configured, this field is not displayed. | <b>detail extensive none</b> |
| <b>ACI Interface Set</b>                | Internally-generated name of the dynamic ACI interface set, if configured, and the set index number of the ACI entry in the session database.                                                                                                                                                                                                          | <b>detail extensive none</b> |

Table 140: show pppoe interfaces Output Fields (*continued*)

| Field Name         | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output  |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Packet Type</b> | <p>Number of packets sent and received during the PPPoE session, categorized by packet type and packet errors:</p> <ul style="list-style-type: none"> <li>• <b>PADI</b>—PPPoE Active Discovery Initiation packets.</li> <li>• <b>PADO</b>—PPPoE Active Discovery Offer packets.</li> <li>• <b>PADR</b>—PPPoE Active Discovery Request packets.</li> <li>• <b>PADS</b>—PPPoE Active Discovery Session-Confirmation packets.</li> <li>• <b>PADT</b>—PPPoE Active Discovery Termination packets.</li> <li>• <b>Service name error</b>—Packets for which the Service-Name request could not be honored.</li> <li>• <b>AC system error</b>—Packets for which the access concentrator experienced an error in performing the host request. For example, the host had insufficient resources to create a virtual circuit.</li> <li>• <b>Generic error</b>—Packets that indicate an unrecoverable error occurred.</li> <li>• <b>Malformed packets</b>—Malformed or short packets that caused the packet handler to discard the frame as unreadable.</li> <li>• <b>Unknown packets</b>—Unrecognized packets.</li> </ul> | <b>extensive</b> |

## Sample Output

### show pppoe interfaces

```
user@host> show pppoe interfaces
pp0.0 Index 66
  State: Down, Session ID: None,
  Service name: None, Configured AC name: sapphire,
  Session AC name: None, Remote MAC address: 00:00:00:00:00:00,
  Auto-reconnect timeout: 100 seconds, Idle timeout: Never,
  Underlying interface: at-5/0/0.0 Index 71
```

### show pppoe interfaces (Status for the Specified Interface)

```
user@host> show pppoe interfaces pp0.1073741827
pp0.1073741827 Index 70
  State: Session Up, Session ID: 30, Type: Dynamic,
  Session AC name: velorum,
  Remote MAC address: 00:90:1A:42:0A:C1,
  Session uptime: 16:45:46 ago,
  Underlying interface: ge-2/0/3.1 Index 73
  Service name: premium
  Dynamic Profile: PppoeProfile
  Agent Circuit ID: velorum-ge-2/0/3
  Agent Remote ID: westford
```

### show pppoe interfaces brief

```
user@host> show pppoe interfaces brief
Interface      Underlying      State      Session      Remote
                interface
pp0.0          ge-2/0/3.2     Session Up  27           00:90:1A:42:0A:C1
pp0.1          ge-2/0/3.2     Session Up  28           00:90:1A:42:0A:C1
pp0.1073741824 ge-2/0/3.1     Session Up  29           00:90:1A:42:0A:C1
```

|                |            |            |    |                   |
|----------------|------------|------------|----|-------------------|
| pp0.1073741825 | ge-2/0/3.1 | Session Up | 30 | 00:90:1A:42:0A:C1 |
| pp0.1073741826 | ge-2/0/3.1 | Session Up | 31 | 00:90:1A:42:0A:C1 |

### show pppoe interfaces detail

```
user@host> show pppoe interfaces detail
pp0.0 Index 66
  State: Down, Session ID: None, Type: Static,
  Service name: None, Configured AC name: sapphire,
  Session AC name: None, Remote MAC address: 00:00:00:00:00:00,
  Auto-reconnect timeout: 100 seconds, Idle timeout: Never,
  Underlying interface: at-5/0/0.0 Index 71
```

### show pppoe interfaces (PPPoE Subscriber Interface with ACI Interface Set)

```
user@host> show pppoe interfaces pp0.1073741827
pp0.1073741827 Index 346
  State: Session Up, Session ID: 4, Type: Dynamic,
  Service name: AGILENT, Remote MAC address: 00:00:64:39:01:02,
  Session AC name: nbc,
  Session uptime: 6d 02:22 ago,
  Dynamic Profile: aci-vlan-pppoe-profile,
  Underlying interface: demux0.1073741826 Index 345
  Agent Circuit ID: aci-ppp-dhcp-dvlan-50
  ACI Interface Set: aci-1002-demux0.1073741826 Index 2
```



## show pppoe service-name-tables

|                                 |                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show pppoe service-name-tables<br><table-name>                                                                                                                                                |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.0.                                                                                                                                                  |
| <b>Description</b>              | Display configuration information about PPPoE service name tables.                                                                                                                            |
| <b>Options</b>                  | <b>none</b> —Display the names of configured PPPoE service name tables.<br><b>table-name</b> —(Optional) Name of a configured PPPoE service name table.                                       |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Verifying a PPPoE Configuration on page 337</a></li> <li>• <a href="#">Verifying and Managing Dynamic PPPoE Configuration</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show pppoe service-name-tables on page 1798</a><br><a href="#">show pppoe service-name-tables (For the Specified Table Name) on page 1798</a>                                     |
| <b>Output Fields</b>            | Table 141 on page 1797 lists the output fields for the <b>show pppoe service-name-tables</b> command. Output fields are listed in the approximate order in which they appear.                 |

Table 141: show pppoe service-name-tables Output Fields

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Level of Output |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Service Name Table</b> | Name of the PPPoE service name table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | none            |
| <b>Service Name</b>       | Name of a configured service in the PPPoE service name table: <ul style="list-style-type: none"> <li>• <b>&lt;empty&gt;</b>—Service of zero length that represents an unspecified service</li> <li>• <b>&lt;any&gt;</b>—Default service for non-empty service entries that do not match the configured empty or named service entries</li> <li>• <b>service-name</b>—Named service entry</li> </ul>                                                                                                                                          | none            |
| <b>Action</b>             | Action taken when the PPPoE underlying interface receives a PPPoE Active Discovery Initiation (PADI) packet with the specified named service, <b>empty</b> service, <b>any</b> service, or ACI/ARI pair: <ul style="list-style-type: none"> <li>• <b>Delay seconds</b>—Number of seconds that the interface delays before responding with a PPPoE Active Discovery Offer (PADO) packet</li> <li>• <b>Drop</b>—Interface drops (ignores) the packet.</li> <li>• <b>Terminate</b>—Interface responds immediately with a PADO packet</li> </ul> | none            |
| <b>Dynamic Profile</b>    | Name of the dynamic profile with which the router creates a dynamic PPPoE subscriber interface. A dynamic profile can be assigned to a named service, <b>empty</b> service, <b>any</b> service, or ACI/ARI pair.                                                                                                                                                                                                                                                                                                                             | none            |

Table 141: show pppoe service-name-tables Output Fields (*continued*)

| Field Name              | Field Description                                                                                                                                                                                                                                                                                                                                                                                           | Level of Output |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Routing Instance</b> | Name of the routing instance in which to instantiate the dynamic PPPoE subscriber interface. A routing instance can be assigned to a named service, <b>empty</b> service, <b>any</b> service, or ACI/ARI pair.                                                                                                                                                                                              | none            |
| <b>Max Sessions</b>     | Maximum number of active PPPoE sessions that the router can establish with the specified named service, <b>empty</b> service, or <b>any</b> service.                                                                                                                                                                                                                                                        | none            |
| <b>Active Sessions</b>  | Current count of active PPPoE sessions created using the specified named service, <b>empty</b> service, or <b>any</b> service. The Active Sessions value cannot exceed the Max Sessions value.                                                                                                                                                                                                              | none            |
| <b>ACI</b>              | Agent circuit identifier (ACI) that corresponds to the DSLAM interface that initiated the client service request. An asterisk is interpreted as a wildcard character and can appear at the beginning, the end, or both the beginning and end of the string. An ACI can be configured as part of an ACI/ARI pair for a named service, <b>empty</b> service, or <b>any</b> service.                           | none            |
| <b>ARI</b>              | Agent remote identifier (ARI) that corresponds to the subscriber associated with the DSLAM interface that initiated the service request. An asterisk is interpreted as a wildcard character and can appear at the beginning, the end, or both at the beginning and end of the string. An ARI can be configured as part of an ACI/ARI pair for a named service, <b>empty</b> service, or <b>any</b> service. | none            |
| <b>Static Interface</b> | Name of the static PPPoE interface reserved for exclusive use by the PPPoE client with matching ACI/ARI information. A static interface can be configured only for an ACI/ARI pair.                                                                                                                                                                                                                         | none            |

## Sample Output

### show pppoe service-name-tables

```

user@host> show pppoe service-name-tables
Service Name Table: test1
Service Name Table: test2
Service Name Table: test3

```

### show pppoe service-name-tables (For the Specified Table Name)

```

user@host> show pppoe service-name-tables Table1
Service Name Table: Table1
  Service Name: <empty>
    Action: Terminate
    Dynamic Profile: BasicPppoeProfile
    Max Sessions: 100
    Active Sessions: 3
  Service Name: <any>
    Action: Drop
    ACI: velorum-ge-2/0/3
    ARI: westford
      Action: Terminate
      Static Interface: pp0.100
    ACI: volantis-ge-5/0/5
    ARI: sunnyvale

```

```
      Action: Terminate
      Static Interface: pp0.101
Service Name: Wholesale
      Action: Terminate
      Dynamic Profile: WholesalePppoeProfile
      Routing Instance: WholesaleRI
      Max Sessions: 16000
      Active Sessions: 4
```

## show pppoe sessions

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Syntax</b>                   | <pre>show pppoe sessions &lt;aci circuit-id-string&gt; &lt;ari remote-id-string&gt; &lt;service service-name&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <b>Description</b>              | Display information about all active PPPoE sessions on the router, or about the active PPPoE sessions established for a specified service name, agent circuit identifier (ACI), or agent remote identifier (ARI).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| <b>Options</b>                  | <p><b>none</b>—Display information for all active PPPoE sessions on the router.</p> <p><b>aci circuit-id-string</b>—(Optional) Display information only for active PPPoE sessions established with the specified agent circuit identifier. The agent circuit identifier corresponds to the DSLAM interface that initiated the service request.</p> <p><b>ari remote-id-string</b>—(Optional) Display information only for active PPPoE sessions established with the specified agent remote identifier. The agent remote identifier corresponds to the subscriber associated with the DSLAM interface that initiated the service request.</p> <p><b>service service-name</b>—(Optional) Display information only for active PPPoE sessions established with the specified service, where <i>service-name</i> can be <b>empty</b>, <b>any</b>, or a named service.</p> |  |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">Verifying a PPPoE Configuration on page 337</a></li> <li>• <a href="#">Verifying and Managing Dynamic PPPoE Configuration</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| <b>List of Sample Output</b>    | <a href="#">show pppoe sessions (For All Active Sessions) on page 1801</a><br><a href="#">show pppoe sessions (For All Active Sessions Matching the Agent Circuit Identifier) on page 1801</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| <b>Output Fields</b>            | Table 142 on page 1800 lists the output fields for the <b>show pppoe sessions</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |

Table 142: show pppoe sessions Output Fields

| Field Name           | Field Description                                                                                   | Level of Output |
|----------------------|-----------------------------------------------------------------------------------------------------|-----------------|
| Interface            | Name of the statically-created or dynamically-created PPPoE interface for the active PPPoE session. | none            |
| Underlying interface | Interface on which PPPoE is running.                                                                | none            |

Table 142: show pppoe sessions Output Fields (*continued*)

| Field Name        | Field Description                                                                                     | Level of Output |
|-------------------|-------------------------------------------------------------------------------------------------------|-----------------|
| <b>State</b>      | State of the PPPoE session; displays <b>Session Up</b> for active PPPoE sessions.                     | none            |
| <b>Session ID</b> | PPPoE session identifier.                                                                             | none            |
| <b>Remote MAC</b> | MAC address of the remote side of the connection, either the access concentrator or the PPPoE client. | none            |

## Sample Output

### show pppoe sessions (For All Active Sessions)

```

user@host> show pppoe sessions
Interface      Underlying      State      Session      Remote
                interface      ID          ID          MAC
pp0.0          ge-2/0/3.2      Session Up  27           00:90:1A:42:0A:C1
pp0.1          ge-2/0/3.2      Session Up  28           00:90:1A:42:0A:C1
pp0.1073741824 ge-2/0/3.1      Session Up  29           00:90:1A:42:0A:C1
pp0.1073741825 ge-2/0/3.1      Session Up  30           00:90:1A:42:0A:C1
pp0.1073741826 ge-2/0/3.1      Session Up  31           00:90:1A:42:0A:C1

```

### show pppoe sessions (For All Active Sessions Matching the Agent Circuit Identifier)

```

user@host> show pppoe sessions aci "velorum-ge-2/0/3"
Interface      Underlying      State      Session      Remote
                interface      ID          ID          MAC
pp0.0          ge-2/0/3.2      Session Up  27           00:90:1A:42:0A:C1
pp0.1          ge-2/0/3.2      Session Up  28           00:90:1A:42:0A:C1

```

## show pppoe statistics

|                                 |                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <code>show pppoe statistics</code><br><code>&lt;logical-interface-name&gt;</code>                                                                                                    |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.<br><i>logical-interface-name</i> option introduced in Junos OS Release 10.1.                                                         |
| <b>Description</b>              | Display statistics information about PPPoE interfaces.                                                                                                                               |
| <b>Options</b>                  | <b>none</b> —Display PPPoE statistics for all interfaces.<br><br><i>logical-interface-name</i> —(Optional) Name of a PPPoE underlying logical interface.                             |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li><code>show ppp address-pool</code></li> <li><a href="#">show pppoe underlying-interfaces on page 1804</a></li> </ul>                          |
| <b>List of Sample Output</b>    | <a href="#">show pppoe statistics on page 1803</a><br><a href="#">show pppoe statistics (For the Specified Underlying Interface Only) on page 1803</a>                               |
| <b>Output Fields</b>            | <a href="#">Table 143 on page 1802</a> lists the output fields for the <b>show pppoe statistics</b> command. Output fields are listed in the approximate order in which they appear. |

**Table 143: show pppoe statistics Output Fields**

| Field Name                   | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Active PPPoE sessions</b> | <p>Total number of active PPPoE sessions and the number of packets sent and received during the PPPoE session, categorized by packet type and packet errors:</p> <ul style="list-style-type: none"> <li><b>PADI</b>—PPPoE Active Discovery Initiation packets.</li> <li><b>PADO</b>—PPPoE Active Discovery Offer packets.</li> <li><b>PADR</b>—PPPoE Active Discovery Request packets.</li> <li><b>PADS</b>—PPPoE Active Discovery Session-Confirmation packets.</li> <li><b>PADT</b>—PPPoE Active Discovery Termination packets.</li> <li><b>Service name error</b>—Packets for which the Service-Name request could not be honored.</li> <li><b>AC system error</b>—Packets for which the access concentrator experienced an error in performing the host request. For example, the host had insufficient resources to create a virtual circuit.</li> <li><b>Generic error</b>—Packets that indicate an unrecoverable error occurred.</li> <li><b>Malformed packets</b>—Malformed or short packets that caused the packet handler to discard the frame as unreadable.</li> <li><b>Unknown packets</b>—Unrecognized packets.</li> </ul> |

Table 143: show pppoe statistics Output Fields (*continued*)

| Field Name      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Timeouts</b> | <p>Information about timeouts that occurred during the PPPoE session (not displayed for M120, M320, and MX Series routers):</p> <ul style="list-style-type: none"> <li>• <b>PADI</b>—No PADR packet has been received within the timeout period. (This value is always zero and is not supported.)</li> <li>• <b>PADO</b>—No PPPoE Active Discovery Offer packet has been received within the timeout period.</li> <li>• <b>PADR</b>—No PADS packet has been received within the timeout period.</li> </ul> |

## Sample Output

### show pppoe statistics

```

user@host> show pppoe statistics
Active PPPoE sessions: 1
  PacketType      Sent      Received
  PADI            0          0
  PADO            0          0
  PADR            0          0
  PADS            0          0
  PADT            0          0
  Service name error 0          0
  AC system error  0          0
  Generic error    0          0
  Malformed packets 0          0
  Unknown packets  0          0
  Timeouts
  PADI            0
  PADO            0
  PADR            0

```

### show pppoe statistics (For the Specified Underlying Interface Only)

```

user@host> show pppoe statistics ge-4/0/3.2
Active PPPoE sessions: 4
  PacketType      Sent      Received
  PADI            0          5
  PADO            5          0
  PADR            0          5
  PADS            4          0
  PADT            0          1
  Service name error 0          0
  AC system error  0          0
  Generic error    0          0
  Malformed packets 0          0
  Unknown packets  0          0

```

## show pppoe underlying-interfaces

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show pppoe underlying-interfaces<br><brief   detail   extensive><br><lockout><br><logical-interface-name>                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.0.<br><b>lockout</b> option added in Junos OS Release 11.4.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Description</b>              | Display information about PPPoE underlying interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | <b>brief   detail   extensive</b> —(Optional) Display the specified level of output.<br><br><b>lockout</b> —(Optional) Display summary information about the lockout condition and the lockout grace period for PPPoE clients on the PPPoE underlying interface.<br><br><b>logical-interface-name</b> —(Optional) Name of a PPPoE underlying logical interface.                                                                                                                                                                             |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <i>Verifying and Managing Dynamic PPPoE Configuration</i></li> <li>• <i>Configuring an Underlying Interface for Dynamic PPPoE Subscriber Interfaces</i></li> <li>• <i>Configuring the PPPoE Family for an Underlying Interface</i></li> <li>• <i>Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration</i></li> </ul>                                                                                                                                                   |
| <b>List of Sample Output</b>    | <a href="#">show pppoe underlying-interfaces brief on page 1806</a><br><a href="#">show pppoe underlying-interfaces detail on page 1807</a><br><a href="#">show pppoe underlying-interfaces extensive on page 1807</a><br><a href="#">show pppoe underlying-interfaces extensive (PPPoE client in lockout condition) on page 1808</a><br><a href="#">show pppoe underlying-interfaces lockout on page 1808</a><br><a href="#">show pppoe underlying-interfaces detail (Autosensing Configured for ACI-based Dynamic VLANs) on page 1808</a> |
| <b>Output Fields</b>            | Table 144 on page 1804 lists the output fields for the <b>show pppoe underlying-interfaces</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                             |

Table 144: show pppoe underlying-interfaces Output Fields

| Field Name           | Field Description                               | Level of Output |
|----------------------|-------------------------------------------------|-----------------|
| Underlying Interface | Name of the PPPoE underlying logical interface. | All levels      |
| Service Name Table   | Name of the service name table.                 | All levels      |



Table 144: show pppoe underlying-interfaces Output Fields (*continued*)

| Field Name                      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Level of Output              |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>Dynamic Profile</b>          | Name of the dynamic profile that was used to create this interface. If the interface was statically created, then the value is <b>none</b> .                                                                                                                                                                                                                                                                                                                                  | All levels                   |
| <b>Index</b>                    | Index number of the logical interface, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                            | <b>detail extensive</b>      |
| <b>State</b>                    | Origin of the logical interface: <b>Static</b> or <b>Dynamic</b> . Indicates whether the interface was statically or dynamically created.                                                                                                                                                                                                                                                                                                                                     | <b>detail extensive</b>      |
| <b>Operational States</b>       | Fields in this block are actual operational values rather than simply the configured values. The operational values can be the result of RADIUS-initiated changes.                                                                                                                                                                                                                                                                                                            | <b>detail extensive</b>      |
| <b>Max Sessions</b>             | Maximum number of PPPoE logical interfaces that can be activated on the underlying interface. When this number of logical interfaces has been established, all subsequent PPPoE Active Discovery Initiation (PADI) packets are dropped and all subsequent PPPoE Active Discovery Request (PADR) packets trigger PPPoE Active Discovery Session (PADS) error responses.                                                                                                        | <b>detail extensive</b>      |
| <b>Max Sessions VSA Ignore</b>  | Whether the router is configured to ignore (clear) the PPPoE maximum session value returned by RADIUS in the Max-Clients-Per-Interface Juniper Networks VSA [26-143] and restore the PPPoE maximum session value on the underlying interface to the value configure with the <b>max-sessions</b> statement: <b>Off</b> (default) or <b>On</b> .                                                                                                                               | <b>detail extensive none</b> |
| <b>Active Sessions</b>          | Number of active PPPoE sessions on the underlying interface. If a dynamic profile is listed, then it is the number of active PPPoE sessions on the underlying interface that are using this profile. The Active Sessions value must not exceed the Max Sessions value.                                                                                                                                                                                                        | <b>detail extensive</b>      |
| <b>Agent Circuit Identifier</b> | Whether the underlying interface is configured to enable creation of (autosense) dynamic VLAN subscriber interfaces based on agent circuit identifier (ACI) information. <b>Autosensing</b> indicates that creation of ACI-based dynamic VLAN interfaces is enabled on the underlying interface. If creation of ACI-based dynamic VLANs is not configured on the underlying interface, this field does not appear.                                                            | <b>detail extensive none</b> |
| <b>Duplicate Protection</b>     | State of PPPoE duplicate protection: <b>On</b> or <b>Off</b> . When duplicate protection is configured for the underlying interface, a dynamic PPPoE logical interface cannot be activated when an existing active logical interface is present for the same PPPoE client. The uniqueness of the PPPoE client is determined by the client's MAC address.                                                                                                                      | <b>detail extensive</b>      |
| <b>Short Cycle Protection</b>   | State of PPPoE short cycle protection: <b>mac-address</b> , <b>circuit-id</b> , or <b>Off</b> . Enabling short cycle protection, also known as PPPoE lockout, on the PPPoE underlying interface temporarily prevents (locks out) a failed or short-lived (short-cycle) PPPoE subscriber session from reconnecting to the router for a default or configurable period of time. PPPoE client sessions are identified by their unique media access control (MAC) source address. | <b>detail extensive</b>      |
| <b>Direct Connect</b>           | State of the configuration to ignore DSL Forum VSAs: <b>On</b> or <b>Off</b> . When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.                                                                                                                                                                                                                                                                          | <b>detail extensive none</b> |

Table 144: show pppoe underlying-interfaces Output Fields (*continued*)

| Field Name                | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Level of Output         |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>AC Name</b>            | Name of the access concentrator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>detail extensive</b> |
| <b>PacketType</b>         | <p>Number of packets sent and received during the PPPoE session, categorized by packet type and packet errors:</p> <ul style="list-style-type: none"> <li>• <b>PADI</b>—PPPoE Active Discovery Initiation packets.</li> <li>• <b>PADO</b>—PPPoE Active Discovery Offer packets.</li> <li>• <b>PADR</b>—PPPoE Active Discovery Request packets.</li> <li>• <b>PADS</b>—PPPoE Active Discovery Session-Confirmation packets.</li> <li>• <b>PADT</b>—PPPoE Active Discovery Termination packets.</li> <li>• <b>Service name error</b>—Packets for which the Service-Name request could not be honored.</li> <li>• <b>AC system error</b>—Packets for which the access concentrator experienced an error in performing the host request. For example, the host had insufficient resources to create a virtual circuit.</li> <li>• <b>Generic error</b>—Packets that indicate an unrecoverable error occurred.</li> <li>• <b>Malformed packets</b>—Malformed or short packets that caused the packet handler to discard the frame as unreadable.</li> <li>• <b>Unknown packets</b>—Unrecognized packets.</li> </ul> | <b>extensive</b>        |
| <b>Lockout Time (sec)</b> | <p>The PPPoE lockout time range, the number of PPPoE clients in lockout condition, and the number of PPPoE clients in a lockout grace period if <b>Short Cycle Protection</b> is enabled (<b>On</b>):</p> <ul style="list-style-type: none"> <li>• <b>Min</b>—Minimum lockout time, in seconds, configured on the PPPoE underlying interface.</li> <li>• <b>Max</b>—Maximum lockout time, in seconds, configured on the PPPoE underlying interface.</li> <li>• <b>Total clients in lockout</b>—Number of PPPoE clients currently undergoing lockout.</li> <li>• <b>Total clients in lockout grace period</b>—Number of PPPoE clients currently in a lockout grace period. A <i>lockout grace period</i> occurs when the time between lockout events is greater than either 15 minutes or the maximum lockout time.</li> </ul>                                                                                                                                                                                                                                                                                  | <b>extensive</b>        |
| <b>Client Address</b>     | MAC source address of the PPPoE client.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>extensive</b>        |
| <b>Current</b>            | Current lockout time, in seconds; displays 0 (zero) if the PPPoE client is not undergoing lockout.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>extensive</b>        |
| <b>Elapsed</b>            | Time elapsed into the lockout period, in seconds; displays 0 (zero) if the PPPoE client is not undergoing lockout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>extensive</b>        |
| <b>Next</b>               | Lockout time, in seconds, that the router uses for the next lockout event; displays a nonzero value if the PPPoE client is currently in a lockout grace period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>extensive</b>        |

## Sample Output

### show pppoe underlying-interfaces brief

```
user@host> show pppoe underlying-interfaces brief
```

| Underlying Interface | Service Name Table | Dynamic Profile |
|----------------------|--------------------|-----------------|
| ge-4/0/3.1           | Premium            | None            |
| ge-4/0/3.2           | None               | PppoeProfile    |

### show pppoe underlying-interfaces detail

```

user@host> show pppoe underlying-interfaces detail
ge-4/0/3.1 Index 73
  Operational States:
  State: Static, Dynamic Profile: None,
  Max Sessions: 4000, Max Sessions VSA Ignore: Off,
  Active Sessions: 0,
  Service Name Table: Premium,
  Direct Connect: Off,
  AC Name: velorum, Duplicate Protection: On,
  Short Cycle Protection: Off

ge-4/0/3.2 Index 78
  Operational States:
  State: Dynamic, Dynamic Profile: PppoeProfile,
  Max Sessions: 500, Max Sessions VSA Ignore: Off,
  Active Sessions: 3,
  Service Name Table: None,
  Direct Connect: Off,
  AC Name: velorum, Duplicate Protection: On,
  Short Cycle Protection: Off

```

### show pppoe underlying-interfaces extensive

```

user@host> show pppoe underlying-interfaces extensive
ge-4/0/3.1 Index 73
  Operational States:
  State: Static, Dynamic Profile: None,
  Max Sessions: 4000, Max Sessions VSA Ignore Off,
  Active Sessions: 0,
  Service Name Table: None,
  Direct Connect: Off,
  AC Name: velorum, Duplicate Protection: Off,
  Short Cycle Protection: Off

```

| PacketType         | Sent | Received |
|--------------------|------|----------|
| PADI               | 0    | 0        |
| PADO               | 0    | 0        |
| PADR               | 0    | 0        |
| PADS               | 0    | 0        |
| PADT               | 0    | 0        |
| Service name error | 0    | 0        |
| AC system error    | 0    | 0        |
| Generic error      | 0    | 0        |
| Malformed packets  | 0    | 0        |
| Unknown packets    | 0    | 0        |

```

ge-4/0/3.2 Index 78
  Operational States:
  State: Dynamic, Dynamic Profile: PppoeProfile,
  Max Sessions: 4000, Max Sessions VSA Ignore: Off
  Active Sessions: 3,
  Service Name Table: None,
  Direct Connect: Off,

```

AC Name: velorum, Duplicate Protection: Off,  
Short Cycle Protection: Off

| PacketType         | Sent | Received |
|--------------------|------|----------|
| PADI               | 0    | 5        |
| PADO               | 5    | 0        |
| PADR               | 0    | 5        |
| PADS               | 4    | 0        |
| PADT               | 0    | 1        |
| Service name error | 0    | 0        |
| AC system error    | 0    | 0        |
| Generic error      | 0    | 0        |
| Malformed packets  | 0    | 0        |
| Unknown packets    | 0    | 0        |

#### show pppoe underlying-interfaces extensive (PPPoE client in lockout condition)

```

user@host> show pppoe underlying-interfaces ge-1/0/0.0 extensive
ge-1/0/0.0 Index 71
  State: Static, Dynamic Profile: None,
  Max Sessions: 32000, Max Sessions VSA Ignore: Off,
  Active Sessions: 0,
  Service Name Table: None,
  Direct Connect: Off,
  AC name: winona, Duplicate Protection: On,
  Short Cycle Protection: Off

  PacketType          Sent      Received
  PADI                 0         7
  PADO                 3         0
  PADR                 0         3
  PADS                 3         0
  PADT                 2         1
  Service name error   0         0
  AC system error      0         0
  Generic error        0         0
  Malformed packets    0         0
  Unknown packets      0         0

  Lockout Time (sec):  Min: 1, Max: 30
  Total clients in lockout: 1
  Total clients in lockout grace period: 0

  Client Address      Current  Elapsed  Next
  00:10:94:00:00:01   4        3        8

```

#### show pppoe underlying-interfaces lockout

```

user@host> show pppoe underlying-interfaces ge-1/0/0.0 lockout
ge-1/0/0.0 Index 71
  Short Cycle Protection: Off,
  Lockout Time (sec):  Min: 10, Max: 60
  Total clients in lockout: 0
  Total clients in lockout grace period: 0

```

#### show pppoe underlying-interfaces detail (Autosensing Configured for ACI-based Dynamic VLANs)

```

user@host> show pppoe underlying-interfaces demux0.1073741826 detail
demux0.1073741826 Index 345
  State: Dynamic, Dynamic Profile: aci-vlan-pppoe-profile,
  Max Sessions: 32000, Max Sessions VSA Ignore: Off,
  Active Sessions: 1,

```

**Agent Circuit Identifier: Autosensing,**  
Service Name Table: None,  
Duplicate Protection: On, Short Cycle Protection: Off,  
Direct Connect: Off,  
AC Name: nbc,  
Short Cycle Protection Level: circuit-id,

## show pppoe version

|                                 |                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show pppoe version                                                                                                                                                                |
| <b>Release Information</b>      | Command introduced before Junos OS Release 7.4.                                                                                                                                   |
| <b>Description</b>              | ( M120 routers and M320 routers only) Display version information about PPPoE.                                                                                                    |
| <b>Options</b>                  | This command has no options.                                                                                                                                                      |
| <b>Required Privilege Level</b> | view                                                                                                                                                                              |
| <b>List of Sample Output</b>    | <a href="#">show pppoe version on page 1810</a>                                                                                                                                   |
| <b>Output Fields</b>            | <a href="#">Table 145 on page 1810</a> lists the output fields for the <b>show pppoe version</b> command. Output fields are listed in the approximate order in which they appear. |

Table 145: show pppoe version Output Fields

| Field Name                | Field Description                                                                                                                                                                                                                                                                   |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| version <i>n</i>          | PPPoE version number and RFC. For example, <b>version 1, rfc 2516</b> .                                                                                                                                                                                                             |
| PPPoE protocol            | State of the PPPoE protocol: <b>enabled</b> or <b>disabled</b> .                                                                                                                                                                                                                    |
| Maximum Sessions          | Maximum active sessions supported per router. The default is 256 sessions.                                                                                                                                                                                                          |
| PADI resend timeout       | Initial time, in seconds, that the router waits to receive a PPOE Active Discovery Offer (PADO) packet for the PPOE Active Discovery Initiation (PADI) packet sent. This timeout doubles for each successive PADI packet sent. Not displayed for M120 and M320 routers.             |
| PADR resend timeout       | Initial time, in seconds, that the router waits to receive a PPOE Active Discovery Session Confirmation (PADS) packet for the PPOE Active Discovery Request (PADR) packet sent. This timeout doubles for each successive PADR packet sent. Not displayed for M120 and M320 routers. |
| Max resend timeout        | Maximum value, in seconds, that the PADI or PADR resend timer can accept. The maximum value is 64. Not displayed for M120 and M320 routers.                                                                                                                                         |
| Max Configured AC timeout | Time, in seconds, during which the configured access concentrator must respond. Not displayed for M120 and M320 routers.                                                                                                                                                            |

## Sample Output

### show pppoe version

```

user@host> show pppoe version
Point-to-Point Protocol Over Ethernet, version 1. rfc2516
  PPPoE protocol           = Enabled
  Maximum Sessions         = 256
  PADI resend timeout      = 2 seconds
  PADR resend timeout      = 16 seconds

```

Max resend timeout           = 64 seconds  
Max Configured AC timeout   = 4 seconds

## show protection-group ethernet-ring aps

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring aps</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4.<br>Command introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Description</b>              | Display the status of the Automatic Protection Switching (APS) and Ring APS (RAPS) messages on an Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring aps (EX Switches) on page 1813</a><br><a href="#">show protection-group ethernet-ring aps (MX RPL Owner Node, Ring in IDLE state) on page 1813</a><br><a href="#">show protection-group ethernet-ring aps (MX Ring Node, Ring in IDLE state) on page 1814</a><br><a href="#">show protection-group ethernet-ring aps (MX RPL Owner Ring Node, Failure condition on non-RPL link of the ring) on page 1814</a><br><a href="#">show protection-group ethernet-ring aps (MX Interconnection Ring Node, Failure condition in major ring on non-RPL link of the ring) on page 1814</a><br><a href="#">show protection-group ethernet-ring aps (MX Series router) on page 1814</a><br><a href="#">show protection-group ethernet-ring aps detail (MX Series router) on page 1814</a><br><a href="#">show protection-group ethernet-ring aps (MX Interconnection Ring Node as RPL owner of major ring, rings in IDLE state) on page 1815</a> |
| <b>Output Fields</b>            | <a href="#">Table 146 on page 1812</a> lists the output fields for the <b>show protection-group ethernet-ring aps</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Table 146: show protection-group ethernet-ring aps Output Fields**

| Field Name           | Field Description                      |
|----------------------|----------------------------------------|
| <b>Ethernet Ring</b> | Name configured for the Ethernet ring. |



**Table 146: show protection-group ethernet-ring aps Output Fields (continued)**

| Field Name                          | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Request/State</b>                | <p>Status of the Ethernet ring RAPS messages.</p> <ul style="list-style-type: none"> <li><b>NR</b>—Indicates that there is no request for APS on the ring.</li> <li><b>SF</b>—Indicates that there is a signal failure on the ring.</li> <li><b>FS</b>—Indicates that there are active forced-switch requests in the ring.</li> <li><b>MS</b>—Indicates that there are active manual-switch requests in the ring.</li> </ul> <p><b>NOTE:</b> Both <b>FS</b> and <b>MS</b> values are valid only when G.8032v2 is supported.</p> |
| <b>Ring Protection Link Blocked</b> | Blocking on the ring protection link: <b>Yes</b> or <b>No</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>No Flush</b>                     | Indicates the value of the Do Not Flush (DNF) flag in the received RAPS PDU. If the value is Yes, then FDB flush is not triggered as part of processing of the received RAPS PDU.                                                                                                                                                                                                                                                                                                                                               |
| <b>Blocked Port Reference</b>       | This parameter is the reference to the blocked ring port. If the east ring port is blocked, the Blocked Port Reference (BPR) value is 0. If the west ring port is blocked, the BPR value is 1. If both ring ports are blocked, this parameter can take any value. If both east and west ports are blocked or not blocked, the value would be 0. This field is valid only when G.8032v2 is supported.                                                                                                                            |
| <b>Originator</b>                   | Indicates whether the node is the originator of the RAPS messages.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Remote Node ID</b>               | Identifier (in MAC address format) of the remote node.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## Sample Output

### show protection-group ethernet-ring aps (EX Switches)

```

user@switch>show protection-group ethernet-ring aps
Ring Name   Request/state No Flush  RPL Blocked  Originator  Remote Node ID
erp1        NR            No        Yes          No          00:1F:12:30:B8:81

```

## Sample Output

### show protection-group ethernet-ring aps (MX RPL Owner Node, Ring in IDLE state)

```

user@host>show protection-group ethernet-ring aps
Ethernet Ring Request/state RPL Blocked  No Flush  BPR
pg_major      NR            Yes         Yes       0

Originator  Remote Node ID
Yes         NA

```

**show protection-group ethernet-ring aps (MX Ring Node, Ring in IDLE state)**

```
user@host>show protection-group ethernet-ring aps
Ethernet Ring   Request/state   RPL Blocked   No Flush
pg102          NR              Yes           Yes

Originator     Remote Node ID
No             00:01:01:00:00:01
```

**show protection-group ethernet-ring aps (MX RPL Owner Ring Node, Failure condition on non-RPL link of the ring)**

```
user@host>show protection-group ethernet-ring aps
Ethernet Ring   Request/state   RPL Blocked   No Flush
pg101          SF              No            No

Originator     Remote Node ID
No             00:01:02:00:00:01
```

**show protection-group ethernet-ring aps (MX Interconnection Ring Node, Failure condition in major ring on non-RPL link of the ring)**

```
user@host>show protection-group ethernet-ring aps
Ethernet Ring   Request/state   RPL Blocked   No Flush   BPR
pg_major        SF              No            No          0
pg_subring      NR              Yes           Yes         0

Originator     Remote Node ID
No             00:01:00:00:00:01
No             00:02:00:00:00:02
```

**show protection-group ethernet-ring aps (MX Series router)**

```
user@host>show protection-group ethernet-ring aps
Ethernet Ring   Request/state   RPL Blocked   No Flush   BPR   Originator   Remote
Node ID
Inst_Vlans_1-15 NR              Yes           Yes         1     Yes         NA

Inst_Vlans_16-30 NR              Yes           Yes         0     No
00:00:00:03:00:02
```

**show protection-group ethernet-ring aps detail (MX Series router)**

```
user@host>show protection-group ethernet-ring aps
Ethernet-Ring name      : Inst_Vlans_1-15
Request/State           : NR
Ring Protection Link blocked : Yes
No Flush Flag           : Yes
Blocked Port Reference   : 1
Originator              : Yes
Remote Node ID          : NA

Ethernet-Ring name      : Inst_Vlans_16-30
Request/State           : NR
Ring Protection Link blocked : Yes
No Flush Flag           : Yes
Blocked Port Reference   : 0
Originator              : No
Remote Node ID          : 00:00:00:03:00:02
```

show protection-group ethernet-ring aps (MX Interconnection Ring Node as RPL owner of major ring, rings in IDLE state)

```
user@host>show protection-group ethernet-ring aps detail
```

|                              |                     |
|------------------------------|---------------------|
| Ethernet-Ring name           | : pg_major          |
| Request/State                | : NR                |
| Ring Protection Link blocked | : Yes               |
| No Flush Flag                | : Yes               |
| Blocked Port Reference       | : 0                 |
| Originator                   | : Yes               |
| Remote Node ID               | : NA                |
|                              |                     |
| Ethernet-Ring name           | : pg_subring        |
| Request/State                | : NR                |
| Ring Protection Link blocked | : Yes               |
| No Flush Flag                | : Yes               |
| Blocked Port Reference       | : 0                 |
| Originator                   | : No                |
| Remote Node ID               | : 00:00:03:00:00:03 |

## show protection-group ethernet-ring configuration

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring configuration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | Command introduced in Junos OS Release 12.1 for EX Series switches.<br>Command introduced in Junos OS Release 14.1 for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Description</b>              | Display the configuration of Ethernet ring protection group on EX Switches and MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul>                                                                                                                                                                               |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring configuration (EX Switch) on page 1818</a><br><a href="#">show protection-group ethernet-ring configuration detail (MX Series Router) on page 1818</a><br><a href="#">show protection-group ethernet-ring configuration (MX Series Router) on page 1819</a><br><a href="#">show protection-group ethernet-ring configuration detail (MX Series Router) on page 1819</a><br><a href="#">show protection-group ethernet-ring configuration detail (MX Series Router) on page 1819</a><br><a href="#">show protection-group ethernet-ring configuration (MX Series Router) on page 1820</a><br><a href="#">show protection-group ethernet-ring configuration detail (MX Series Router) on page 1821</a> |
| <b>Output Fields</b>            | <a href="#">Table 147 on page 1816</a> lists the output fields for the <b>show protection-group ethernet-ring configuration</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table 147: show protection-group ethernet-ring configuration Output Fields**

| Output Fields                      | Field Description                                                                                                                                                  |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>G8032 Compatibility Version</b> | This is the compatibility version mode of ERP. This parameter always takes the value 1 in the case of G8032v1. This parameter is valid only for MX Series routers. |
| <b>East Interface</b>              | One of the two switch interfaces that participates in a ring link. When Junos supports G8032v2, this interface is treated as interface 0.                          |
| <b>West Interface</b>              | One of the two interfaces in a switch that participates in a ring link. When Junos supports G8032v2, this interface is treated as interface 1.                     |

**Table 147: show protection-group ethernet-ring configuration Output Fields (continued)**

| Output Fields                      | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Restore Interval</b>            | Configured interval of wait time after a link is restored. When a link goes down, the RPL link is activated. When the down link becomes active again, the RPL owner receives a notification. The RPL owner waits for the restore interval before issuing a block on the RPL link. The configured restore interval can be 5 through 12 minutes for ERPV1 and 1 through 12 minutes for ERPV2. This configuration is a global configuration and applies to all Ethernet rings if the Ethernet ring does not have a more specific configuration for this value. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value. |
| <b>Wait to Block Interval</b>      | Configured interval of wait time for link restoration when a manual command (manual switch or force switch) is cleared. On clearing the manual command, the RPL owner receives NR messages, which starts a timer with interval 'Wait to Block' to restore the RPL link after its expiration. This delay timer is set to be 5 seconds longer than the guard timer. The configured number can be from 5 seconds through 10 seconds. The parameter is valid only for G.8032v2.                                                                                                                                                                                                                 |
| <b>Guard Interval</b>              | Configured number of milliseconds (in 10 millisecond intervals, 10 milliseconds through 2000 milliseconds) that the node does not process any Ethernet ring protection protocol data units (PDUs). This configuration is a global configuration and applies to all Ethernet rings if the Ethernet ring does not have a more specific configuration for this value. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value.                                                                                                                                                                                          |
| <b>Hold off interval</b>           | This is the interval at which the link is held down even before declaring that the link is down. Because the parameter is not supported at present, its value is always considered 0. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Node ID</b>                     | Node ID for the switch or router. If the node ID is not configured, it is assigned by default. For EX Series switches, the Node ID value cannot be configured, whereas for MX Series routers, it can be configured..                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Ring ID</b>                     | In G8032v2, the ring ID can be within the range 1–239. All the nodes in a ring should have the same ring ID. In the case of G8032v1, the value of the ring ID is always 1. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Node Role</b>                   | Indicates whether the ring node is operating as a normal ring-node or RPL-owner or RPL-neighbor. For G8032v1 RPL-neighbor role is not supported. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Revertive Mode of Operation</b> | This parameter indicates whether the ring is operating in revertive mode or nonrevertive mode. In nonrevertive mode of operation, when all links in the ring and Ethernet Ring Nodes have recovered and no external requests are active, the Ethernet Ring does not automatically revert. G8032v1 supports only revertive mode of operation. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                                                                                            |
| <b>RAPS Tx Dot1p priority</b>      | The RAPS Tx Dot1p priority is a parameter with which the RAPS is transmitted from the ring node. For G8032v1, the value of this parameter is always 0. For G8032v2, the value of this parameter can be within the range 0–7. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                                                                                                                                                                                                            |

Table 147: show protection-group ethernet-ring configuration Output Fields (*continued*)

| Output Fields                          | Field Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Node type</b>                       | Indicates whether ring node is a normal ring node having two ring-links or a open ring-node having only a single ring-link or a interconnection ring-node. An interconnection ring node can be connected to major ring in non virtual-channel mode or in virtual channel mode. Ring interconnection is not supported for G8032v1. This parameter is valid only for MX Series routers.                                    |
| <b>Major ring name</b>                 | If the node type is interconnection in the ring, this parameter takes the name of the major ring to which the sub-ring node is connected. This parameter is valid only for MX Series routers.                                                                                                                                                                                                                            |
| <b>Interconnection mode</b>            | Indicates the interconnection mode if the type of the node is interconnection. An interconnection ring node can be connected to major ring in non-virtual channel mode or in virtual channel mode. This parameter is valid only for MX Series routers.                                                                                                                                                                   |
| <b>Propagate Topology Change event</b> | When Propagate Topology Change event is set to 1, the change in the topology of sub-ring is propagated to the major ring, enabling the transmission of EVENT FLUSH RAPS PDU in the major ring. When the parameter is set to 0, the topology change in the sub-ring is not propagated to the major ring blocking EVENT FLUSH RAPS PDU transmission in the major ring. This parameter is valid only for MX Series routers. |
| <b>Control Vlan</b>                    | The VLAN that transfers ERP PDUs from one node to another.                                                                                                                                                                                                                                                                                                                                                               |
| <b>Physical Ring</b>                   | Physical ring if the east and west interfaces are nontrunk ports. For MX Series routers, the ring is termed a physical ring if no data channels are defined for the ring and the entire physical port forwarding is controlled by ERP.                                                                                                                                                                                   |
| <b>Data Channel VLAN(s)</b>            | Data VLANs for which forwarding behavior is controlled by the ring instance.                                                                                                                                                                                                                                                                                                                                             |

## Sample Output

### show protection-group ethernet-ring configuration (EX Switch)

```

user@switch>show protection-group ethernet-ring configuration
Ethernet ring configuration parameters for protection group erp1
East Interface   : ge-0/0/3.0
West Interface   : ge-0/0/9.0
Restore Interval : 5 minutes
Guard Interval   : 500 ms
Node Id          : 00:1F:12:30:B8:81
Control Vlan     : 101
Physical Ring     : yes

```

### show protection-group ethernet-ring configuration detail (MX Series Router)

```

user@switch>show protection-group ethernet-ring configuration detail
Ethernet Ring configuration information for protection group pg_101
G8032 Compatibility Version      : 2
East interface (interface 0)     : xe-2/3/0.1
West interface (interface 1)     : xe-2/2/1.1
Restore interval                  : 5 minutes

```

```

Wait to Block interval          : 5 seconds
Guard interval                  : 500 ms
Hold off interval               : 0 ms
Node ID                         : 64:87:88:65:37:D0
Ring ID (1 ... 239)            : 1
Node role (normal/rpl-owner/rpl-neighbour) : normal
Revertive mode of operation     : 1
RAPS Tx Dot1p priority (0 .. 7) : 0
Node type (normal/open/interconnection) : Normal
Control Vlan                    : 100
Physical Ring                   : No
Data Channel Vlan(s)           : 200,300

```

#### show protection-group ethernet-ring configuration (MX Series Router)

```

user@switch>show protection-group ethernet-ring configuration
Ethernet Ring configuration information for protection group pg_101
G8032 Compatibility Version      : 2
East interface (interface 0)     : xe-2/3/0.1
West interface (interface 1)     : xe-2/2/1.1
Restore interval                 : 5 minutes
Wait to Block interval          : 5 seconds
Guard interval                   : 500 ms
Hold off interval               : 0 ms
Node ID                         : 64:87:88:65:37:D0
Ring ID (1 ... 239)            : 1
Node role (normal/rpl-owner/rpl-neighbour) : rpl-neighbour
Node RPL end                     : east-port
Revertive mode of operation     : 1
RAPS Tx Dot1p priority (0 .. 7) : 0
Node type (normal/open/interconnection) : Normal
Control Vlan                    : 100
Physical Ring                   : No
Data Channel Vlan(s)           : 200,300

```

#### show protection-group ethernet-ring configuration detail (MX Series Router)

```

user@switch>show protection-group ethernet-ring configuration detail
Ethernet Ring configuration information for protection group pg_101
G8032 Compatibility Version      : 2
East interface (interface 0)     : xe-2/3/0.1
West interface (interface 1)     : xe-2/2/1.1
Restore interval                 : 5 minutes
Wait to Block interval          : 5 seconds
Guard interval                   : 500 ms
Hold off interval               : 0 ms
Node ID                         : 64:87:88:65:37:D0
Ring ID (1 ... 239)            : 1
Node role (normal/rpl-owner/rpl-neighbour) : rpl-owner
Node RPL end                     : east-port
Revertive mode of operation     : 1
RAPS Tx Dot1p priority (0 .. 7) : 0
Node type (normal/open/interconnection) : Normal
Control Vlan                    : 100
Physical Ring                   : No
Data Channel Vlan(s)           : 200,300

```

#### show protection-group ethernet-ring configuration detail (MX Series Router)

```

user@switch>show protection-group ethernet-ring configuration detail
Ethernet Ring configuration information for protection group pg_101
G8032 Compatibility Version      : 2

```

```

East interface (interface 0)          : xe-2/3/0.1
West interface (interface 1)         : (no erp)
Restore interval                      : 5 minutes
Wait to Block interval               : 5 seconds
Guard interval                      : 500 ms
Hold off interval                    : 0 ms
Node ID                              : 64:87:88:65:37:D0
Ring ID (1 ... 239)                 : 1
Node role (normal/rpl-owner/rpl-neighbour) : rpl-owner
Node RPL end                         : east-port
Revertive mode of operation          : 1
RAPS Tx Dot1p priority (0 .. 7)     : 0
Node type (normal/open/interconnection) : Open
Control Vlan                         : 100
Physical Ring                        : No
Data Channel Vlan(s)                 : 200,300

```

### show protection-group ethernet-ring configuration (MX Series Router)

```

user@switch>show protection-group ethernet-ring configuration
Ethernet Ring configuration information for protection group pg_major
G8032 Compatibility Version          : 2
East interface (interface 0)        : xe-2/3/0.1
West interface (interface 1)        : xe-2/2/1.1
Restore interval                    : 5 minutes
Wait to Block interval              : 5 seconds
Guard interval                     : 500 ms
Hold off interval                   : 0 ms
Node ID                             : 64:87:88:65:37:D0
Ring ID (1 ... 239)                 : 1
Node role (normal/rpl-owner/rpl-neighbour) : rpl-owner
Node RPL end                        : east-port
Revertive mode of operation         : 1
RAPS Tx Dot1p priority (0 .. 7)    : 0
Node type (normal/open/interconnection) : Normal
Control Vlan                        : 100
Physical Ring                       : No
Data Channel Vlan(s)                : 200,300

Ethernet Ring configuration information for protection group pg_subring
G8032 Compatibility Version          : 2
East interface (interface 0)        : ge-2/0/0.1
West interface (interface 1)        : (no erp)
Restore interval                    : 5 minutes
Wait to Block interval              : 5 seconds
Guard interval                     : 500 ms
Hold off interval                   : 0 ms
Node ID                             : 64:87:88:65:37:D0
Ring ID (1 ... 239)                 : 2
Node role (normal/rpl-owner/rpl-neighbour) : normal
Revertive mode of operation         : 1
RAPS Tx Dot1p priority (0 .. 7)    : 0
Node type (normal/open/interconnection) : Non-VC-Interconnection
Major ring name                     : pg_major
Interconnection mode (VC/Non-VC)   : Non-VC mode
Propagate Topology Change event    : 0
Control Vlan                        : 101
Physical Ring                       : No
Data Channel Vlan(s)                : 200,300

```



**show protection-group ethernet-ring configuration detail (MX Series Router)**

```

user@switch>show protection-group ethernet-ring configuration detail
Ethernet Ring configuration information for protection group pg_major
G8032 Compatibility Version          : 2
East interface (interface 0)        : xe-2/3/0.1
West interface (interface 1)        : xe-2/2/1.1
Restore interval                     : 5 minutes
Wait to Block interval              : 5 seconds
Guard interval                      : 500 ms
Hold off interval                   : 0 ms
Node ID                             : 64:87:88:65:37:D0
Ring ID (1 ... 239)                 : 1
Node role (normal/rpl-owner/rpl-neighbour) : rpl-owner
Node RPL end                        : east-port
Revertive mode of operation          : 1
RAPS Tx Dot1p priority (0 .. 7)     : 0
Node type (normal/open/interconnection) : Normal
Control Vlan                        : 100
Physical Ring                       : No
Data Channel Vlan(s)                 : 200,300

Ethernet Ring configuration information for protection group pg_subring
G8032 Compatibility Version          : 2
East interface (interface 0)        : ge-2/0/0.1
West interface (interface 1)        : (no erp)
Restore interval                     : 5 minutes
Wait to Block interval              : 5 seconds
Guard interval                      : 500 ms
Hold off interval                   : 0 ms
Node ID                             : 64:87:88:65:37:D0
Ring ID (1 ... 239)                 : 2
Node role (normal/rpl-owner/rpl-neighbour) : normal
Revertive mode of operation          : 1
RAPS Tx Dot1p priority (0 .. 7)     : 0
Node type (normal/open/interconnection) : Non-VC-Interconnection
Major ring name                     : pg_major
Interconnection mode (VC/Non-VC)    : Non-VC mode
Propagate Topology Change event     : 0
Control Vlan                        : 101
Physical Ring                       : No
Data Channel Vlan(s)                 : 200,300

```

## show protection-group ethernet-ring data-channel

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show protection-group ethernet-ring data-channel<br><brief   detail><br><group-name <i>group-name</i> >                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>              | On MX Series routers, display data channel information for all Ethernet ring protection groups or for a specific Ethernet ring protection group.                                                                                                                                                                                                                                                                                                                              |
| <b>Options</b>                  | <b>brief   detail</b> —(Optional) Display the specified level of output.<br><br><b>group-name</b> —(Optional) Protection group for which to display statistics. If you omit this optional field, all protection group statistics for configured groups will be displayed.                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring data-channel on page 1823</a><br><a href="#">show protection-group ethernet-ring data-channel detail on page 1823</a>                                                                                                                                                                                                                                                                                                         |
| <b>Output Fields</b>            | Table 148 on page 1822 lists the output fields for the <b>show protection-group ethernet-ring data-channel</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                               |

**Table 148: show protection-group ethernet-ring data-channel Output Fields**

| Field Name       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Interface</b> | Name of the interface configured for the Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>STP index</b> | The Spanning Tree Protocol (STP) index number used by each interface in an Ethernet ring. The STP index controls the forwarding behavior for a set of VLANs on a data channel on an Ethernet ring port. For multiple Ethernet ring instances on an physical ring port, there are multiple STP index numbers. Different ring instances will have different STP index numbers and may have different forwarding behavior. |

Table 148: show protection-group ethernet-ring data-channel Output Fields (*continued*)

| Field Name    | Field Description                                                                                                                                                                                                       |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Forward State | Forwarding state on the Ethernet ring. <ul style="list-style-type: none"> <li>• <b>forwarding</b>—Indicates packets are being forwarded.</li> <li>• <b>discarding</b>—Indicates packets are being discarded.</li> </ul> |

## Sample Output

### show protection-group ethernet-ring data-channel

```
user@host> show protection-group ethernet-ring data-channel
Ethernet ring data channel information for protection group pg301

Interface    STP index  Forward State
xe-5/0/2     78         forwarding
xe-2/2/0     79         discarding

Ethernet ring data channel parameters for protection group pg302

Interface    STP index  Forward State
xe-5/0/2     80         forwarding
xe-2/2/0     81         forwarding
```

### show protection-group ethernet-ring data-channel detail

```
user@host> show protection-group ethernet-ring data-channel detail
Ethernet ring data channel parameters for protection group pg301

Interface name      : xe-5/0/2
STP index           : 78
Forward State       : forwarding

Interface name      : xe-2/2/0
STP index           : 79
Forward State       : discarding

Ethernet ring data channel parameters for protection group pg302

Interface name      : xe-5/0/2
STP index           : 80
Forward State       : forwarding

Interface name      : xe-2/2/0
STP index           : 81
Forward State       : forwarding
```

## show protection-group ethernet-ring flush-info

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring flush-info</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Command introduced in Junos OS Release 14.2.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Display information about flush ports in an Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring flush-info (MX Series Router) on page 1824</a><br><a href="#">show protection-group ethernet-ring flush-info detail (MX Series Router) on page 1825</a>                                                                                                                                                                                                                                                                          |
| <b>Output Fields</b>            | Table 149 on page 1824 lists the output fields for the <b>show protection-group ethernet-ring flush-info</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                    |

Table 149: show protection-group ethernet-ring flush-info Output Fields

| Field Name                    | Field Description                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------------|
| <b>Interface</b>              | Physical interface configured for the Ethernet ring. This can be an aggregated Ethernet link also. |
| <b>Originating Node</b>       | Node from which RAPS protocol data units originates on the Ethernet Ring.                          |
| <b>Blocked Port Reference</b> | Reference of the ring port on which traffic is blocked.                                            |

## Sample Output

### show protection-group ethernet-ring flush-info (MX Series Router)

```

user@host> show protection-group ethernet-ring flush-info
Ethernet ring flush port information for protection group pg100

Interface      Originating Node  Blocked Port Reference
xe-5/0/2.4001  00:00:00:00:00:00  0
xe-2/2/0.4001  00:00:00:00:00:00  0

```

**show protection-group ethernet-ring flush-info detail (MX Series Router)**

```
user@host> show protection-group ethernet-ring flush-info detail
Ethernet ring flush port information for protection group pg100

Interface name           : xe-5/0/2.4001
Originating Node         : 00:00:00:00:00:00
Blocked Port Reference    : 0

Interface name           : xe-2/2/0.4001
Originating Node         : 00:00:00:00:00:00
Blocked Port Reference    : 0
```

## show protection-group ethernet-ring interface

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring interface</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description</b>              | Displays the status of the Automatic Protection Switching (APS) interfaces on an Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul>                                                                                |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring interface (EX Series Switch Owner Node) on page 1827</a><br><a href="#">show protection-group ethernet-ring interface (Owner Node MX Series Router ) on page 1827</a><br><a href="#">show protection-group ethernet-ring interface detail (Owner Node MX Series Router ) on page 1827</a><br><a href="#">show protection-group ethernet-ring interface (EX Series Switch Ring Node) on page 1827</a><br><a href="#">show protection-group ethernet-ring interface (MX Series Router Ring Node) on page 1828</a> |
| <b>Output Fields</b>            | Table 150 on page 1826 lists the output fields for both the EX Series switch and the MX Series router <b>show protection-group ethernet-ring interface</b> commands. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                    |

**Table 150: MX Series Routers show protection-group ethernet-ring interface Output Fields**

| Field Name                                                           | Field Description                                                                                   |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Ethernet ring port parameters for protection group <i>group-name</i> | Output is organized by configured protection group.                                                 |
| Interface                                                            | Physical interfaces configured for the Ethernet ring. This can be an aggregated Ethernet link also. |
| Control Channel                                                      | (MX Series router only) Logical unit configured on the physical interface.                          |
| Forward State                                                        | State of the ring forwarding on the interface: <b>discarding</b> or <b>forwarding</b> .             |

**Table 150: MX Series Routers show protection-group ethernet-ring interface Output Fields (*continued*)**

| Field Name               | Field Description                                                                                                                                        |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ring Protection Link End | Whether this interface is the end of the ring: <b>Yes</b> or <b>No</b> .                                                                                 |
| Signal Failure           | Whether there a signal failure exists on the link: <b>Clear</b> or <b>Set</b> .                                                                          |
| Admin State              | State of the interface: For EX switches, <b>ready</b> , <b>ifl ready</b> , or <b>waiting</b> . For MX routers, <b>IFF ready</b> or <b>IFF disabled</b> . |

## Sample Output

### show protection-group ethernet-ring interface (EX Series Switch Owner Node)

```
user@host> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface      Forward State  RPL End  Signal Failure  Admin State
ge-0/0/3.0     discarding    Yes      Clear          ready
ge-0/0/9.0     forwarding    No       Clear          ready
```

### show protection-group ethernet-ring interface (Owner Node MX Series Router )

```
user@host> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface  Control Channel  Direction  Forward State  RPL End  SF      Admin State
ge-1/2/0   ge-1/2/0.100    east      forwarding    No       Clear  IFF ready
ge-1/2/2   ge-1/2/2.100    west      forwarding    No       Clear  IFF ready
```

### show protection-group ethernet-ring interface detail (Owner Node MX Series Router )

```
user@host> show protection-group ethernet-ring interface detail
Ethernet ring port parameters for protection group pg101

Interface name           : ge-1/2/0
Control channel name     : ge-1/2/0.100
Interface direction      : east
Ring Protection Link End : No
Signal Failure           : Clear
Forward State            : forwarding
Interface Admin State    : IFF ready

Interface name           : ge-1/2/2
Control channel name     : ge-1/2/2.100
Interface direction      : west
Ring Protection Link End : No
Signal Failure           : Clear
Forward State            : forwarding
Interface Admin State    : IFF ready
```

### show protection-group ethernet-ring interface (EX Series Switch Ring Node)

```
user@host> show protection-group ethernet-ring interface
```

Ethernet ring port parameters for protection group pg102

Ethernet ring port parameters for protection group pg101

| Interface  | Forward State | RPL End | Signal Failure | Admin State |
|------------|---------------|---------|----------------|-------------|
| ge-0/0/3.0 | discarding    | Yes     | Clear          | ready       |
| ge-0/0/9.0 | forwarding    | No      | Clear          | ready       |

#### show protection-group ethernet-ring interface (MX Series Router Ring Node)

```
user@host> show protection-group ethernet-ring interface
```

Ethernet ring port parameters for protection group pg102

| Interface | Control Channel | Forward State | RPL End |
|-----------|-----------------|---------------|---------|
| ge-1/2/1  | ge-1/2/1.1      | forwarding    | No      |
| ge-1/0/2  | ge-1/0/2.1      | forwarding    | No      |

| Signal Failure | Admin State |
|----------------|-------------|
| Clear          | IFF ready   |
| Clear          | IFF ready   |



## show protection-group ethernet-ring node-state

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring node-state</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4 for MX Series routers.<br>Command introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description</b>              | Display the status of the Automatic Protection Switching (APS) nodes on an Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | This command has no options.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Normal Operation) on page 1831</a><br><a href="#">show protection-group ethernet-ring node-state (MX Series Router - Normal Ring Node, Normal Operation) on page 1831</a><br><a href="#">show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Remote Failure Condition) on page 1831</a><br><a href="#">show protection-group ethernet-ring node-state (MX Series Router - Owner Node, Local Failure Condition) on page 1831</a><br><a href="#">show protection-group ethernet-ring node-state detail (MX Series Routers - Node state at RPL-owner after signal failure condition is cleared in the ring and before reversion) on page 1831</a><br><a href="#">show protection-group ethernet-ring node-state detail (MX Series Router - RPL Owner Node, Normal Operation) on page 1831</a> |
| <b>Output Fields</b>            | <a href="#">Table 151 on page 1829</a> lists the output fields for the <b>show protection-group ethernet-ring node-state</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**Table 151: show protection-group ethernet-ring node-state Output Fields**

| Field Name                | Field Description                      |
|---------------------------|----------------------------------------|
| Ring Name / Ethernet Ring | Name configured for the Ethernet ring. |

Table 151: show protection-group ethernet-ring node-state Output Fields (*continued*)

| Field Name                             | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| APS State                              | <p>State of the Ethernet ring APS.</p> <ul style="list-style-type: none"> <li>• <b>idle</b>—Indicates that the ring is working in normal condition and there is no active or pending protection-switching request in the ring. When the ring is in idle state, it is blocked at the RPL link.</li> <li>• <b>protected</b>—Indicates that there is a protection switch on the ring because of a signal failure condition on the ring link.</li> <li>• <b>MS</b>—Indicates that the manual switch command is active in the ring.</li> <li>• <b>FS</b>—Indicates that the forced switch command is active in the ring.</li> <li>• <b>pending</b>—Indicates that the ring is in pending state.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Event                                  | <p>Events on the ring.</p> <ul style="list-style-type: none"> <li>• <b>NR-RB</b>—Indicates that there is no APS request and the ring link is blocked on the ring owner node.</li> <li>• <b>NR</b>—Indicates that there is no APS request pending in the ring.</li> <li>• <b>local SF</b>—Indicates that there is signal failure on one or both of the ring links of the node.</li> <li>• <b>remote SF</b>—Indicates that there is signal failure on one or more ring links of any other node of the ring.</li> <li>• <b>local FS</b>—Indicates that there is a forced switched command active on one or both of the ring links of the node.</li> <li>• <b>remote FS</b>—Indicates that there is a forced switch command active on one or more ring links of any other node of the ring.</li> <li>• <b>local MS</b>—Indicates that there is a manual switch command active on one of the ring links of the node.</li> <li>• <b>remote MS</b>—Indicates that there is a manual switch command active on one or more ring links of any other node of the ring.</li> <li>• <b>WTR running</b>—Indicates that the wait to restore timer is running on the RPL owner.</li> <li>• <b>WTB running</b>—Indicates that the wait to block timer is running on the RPL owner.</li> </ul> |
| RPL Owner / Ring Protection Link Owner | Whether this node is the ring owner: <b>Yes</b> or <b>No</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| WTR Timer / Restore Timer              | Restoration timer: <b>running</b> or <b>disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| WTB Timer / Wait to block timer        | Wait to block timer: <b>running</b> or <b>disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Guard Timer                            | Guard timer: <b>running</b> or <b>disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Op State / Operational State           | State of the node: <b>Operational</b> or <b>any internal wait state..</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Sample Output

### show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Normal Operation)

```
user@host> show protection-group ethernet-ring node-state
Ethernet ring  APS State  Event      RPL Owner  WTR Timer  WTB Timer  Guard
Timer  Operation state
pg101        idle      NR-RB      Yes        disabled   disabled   disabled
operational
pg102        idle      NR-RB      No         disabled   disabled   disabled
operational
```

### show protection-group ethernet-ring node-state (MX Series Router - Normal Ring Node, Normal Operation)

```
user@host> show protection-group ethernet-ring node-state
Ethernet ring  APS State  Event      RPL Owner
pg102         idle      NR-RB      No

WTR Timer  WTB Timer  Guard Timer  Operation state
disabled   disabled   disabled     operational
```

### show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Remote Failure Condition)

```
user@host> show protection-group ethernet-ring node-state
Ethernet ring  APS State  Event      RPL Owner
pg101         protected  remote SF   Yes

WTR Timer  WTB Timer  Guard Timer  Operation state
disabled    disabled   disabled     operational
```

### show protection-group ethernet-ring node-state (MX Series Router - Owner Node, Local Failure Condition)

```
user@host> show protection-group ethernet-ring node-state
Ethernet ring  APS State  Event      RPL Owner
pg102         protected  local SF    No

WTR Timer  WTB Timer  Guard Timer  Operation state
disabled    disabled   disabled     operational
```

### show protection-group ethernet-ring node-state detail (MX Series Routers - Node state at RPL-owner after signal failure condition is cleared in the ring and before reversion)

```
user@host> show protection-group ethernet-ring node-state detail

Ethernet-Ring name      : pg_major
APS State               : pending
Event                   : WTR running
Ring Protection Link Owner : Yes
Wait to Restore Timer    : running (time to expire: 269 sec)
Wait to Block Timer      : disabled
Guard Timer             : disabled
Operation state          : operational
```

### show protection-group ethernet-ring node-state detail (MX Series Router - RPL Owner Node, Normal Operation)

```
user@host> show protection-group ethernet-ring node-state detail

Ethernet-Ring name      : pg101
APS State               : idle
Event                   : NR-RB
Ring Protection Link Owner : Yes
Wait to Restore Timer    : disabled
```

|                            |               |
|----------------------------|---------------|
| Wait to Block Timer        | : disabled    |
| Guard Timer                | : disabled    |
| Operation state            | : operational |
|                            |               |
| Ethernet-Ring name         | : pg102       |
| APS State                  | : idle        |
| Event                      | : NR-RB       |
| Ring Protection Link Owner | : No          |
| Wait to Restore Timer      | : disabled    |
| Wait to Block Timer        | : disabled    |
| Guard Timer                | : disabled    |
| Operation state            | : operational |

## show protection-group ethernet-ring statistics

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <b>show protection-group ethernet-ring statistics</b> <group-name <i>group-name</i> ><br><brief   detail>                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Command introduced in Junos OS Release 9.4.<br>Command introduced in Junos OS Release 12.1 for EX Series switches.                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description</b>              | Display statistics regarding Automatic Protection Switching (APS) protection groups on an Ethernet ring.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <b>group-name</b> —Display statistics for the protection group. If you omit this option, protection group statistics for all configured groups are displayed.<br><br><b>brief</b> —Display brief statistics for the protection group.<br><br><b>detail</b> —Display detailed statistics for the protection group.                                                                                                                                                               |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring vlan on page 1837</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring statistics (EX Series Switch) on page 1835</a><br><a href="#">show protection-group ethernet-ring statistics (MX Series Router) on page 1835</a><br><a href="#">show protection-group ethernet-ring statistics detail (Specific Group)(MX Series Router) on page 1835</a>                                                                                                                                                       |
| <b>Output Fields</b>            | Table 152 on page 1833 lists the output fields for the <b>show protection-group ethernet-ring statistics</b> command.                                                                                                                                                                                                                                                                                                                                                           |

**Table 152: show protection-group ethernet-ring statistics Output Fields**

| Field Name                      | Field Description                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ethernet Ring Statistics for PG | Name of the protection group for which statistics are displayed.                                                                                                |
| RAPS event sent                 | Number of times Ring Automatic Protection Switching (RAPS) message transmission event occurred locally. This field is applicable only to MX Series routers.     |
| RAPS event received             | Number of RAPS messages received and processed by ERP state-machine and which resulted in state transition. This field is applicable only to MX Series routers. |

**Table 152: show protection-group ethernet-ring statistics Output Fields (continued)**

| Field Name                      | Field Description                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Local SF</b>                 | Number of times a signal failure has occurred locally.                                                                                               |
| <b>Remote SF</b>                | Number of times a signal failure has occurred anywhere else on the ring.                                                                             |
| <b>NR event</b>                 | Number of times a No Request event has occurred on the ring. This field is applicable only to EX Series switches.                                    |
| <b>NR event sent</b>            | Number of times a No Request event has occurred locally. This field is applicable only to MX Series routers.                                         |
| <b>NR event received</b>        | Number of times a No Request event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.                       |
| <b>NR-RB event</b>              | Number of times a No Request, Ring Blocked event has occurred on the ring. This field is applicable only to EX Series switches.                      |
| <b>NR-RB event sent</b>         | Number of times a No Request, Ring Blocked event has occurred locally. This field is applicable only to MX Series routers.                           |
| <b>NR-RB event received</b>     | Number of times a No Request, Ring Blocked event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.         |
| <b>Flush event sent</b>         | Number of times flush-event RAPS message transmission event occurred locally. This field is applicable only to MX Series routers.                    |
| <b>Flush event received</b>     | Number of flush-event RAPS messages received and processed by the ring instance control process. This field is applicable only to MX Series routers. |
| <b>Local FS event sent</b>      | Number of times a forced switch event has occurred locally. This field is applicable only to MX Series routers.                                      |
| <b>Remote FS event received</b> | Number of times a forced switch event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.                    |
| <b>Local MS event sent</b>      | Number of times a manual switch event has occurred locally. This field is applicable only to MX Series routers.                                      |
| <b>Remote MS event received</b> | Number of times a manual switch event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.                    |

Table 153 on page 1835 lists the output fields for the **show protection-group ethernet-ring statistics** command when the **detail** option is used. These fields are valid only for MX Series routers.

**Table 153: show protection-group ethernet-ring statistics detail Output Fields (for MX Series Routers)**

| Field Name                                      | Field Description                                                                                                                |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Total number of FDB flush</b>                | Number of times forwarding database (FDB) flush has happened for the ring instance.                                              |
| <b>Flush-logic triggered flush</b>              | Number of times FDB flush has happened because of flush-logic based on node ID and Blocked Port Reference (BPR).                 |
| <b>Remote RAPS PDU received</b>                 | Number of valid RAPS PDU messages received. This counter counts only RAPS messages generated by other devices on the ring.       |
| <b>Remote RAPS dropped due to guard-timer</b>   | Number of RAPS messages dropped by the device because the guard timer is running.                                                |
| <b>Invalid remote RAPS PDU dropped</b>          | Number of RAPS messages dropped by the device because the messages are invalid.                                                  |
| <b>RAPS dropped due to miscellaneous errors</b> | Number of RAPS messages dropped because of any other reason. For example, messages dropped because of unsupported functionality. |
| <b>Local received RAPS PDU dropped</b>          | Number of self-generated RAPS messages received and dropped.                                                                     |

## Sample Output

### show protection-group ethernet-ring statistics (EX Series Switch)

```
user@switch> show protection-group ethernet-ring statistics
Ring Name Local SF Remote SF NR Event NR-RB Event
erp1      2      1      2      3
```

### show protection-group ethernet-ring statistics (MX Series Router)

```
user@host> show protection-group ethernet-ring statistics
Ethernet Ring statistics for PG Pg-1
RAPS event sent           : 1
RAPS event received       : 1152
Local SF happened:        : 0
Remote SF happened:       : 428
NR event sent:            : 1
NR event received:        : 133
NR-RB event sent:         : 0
NR-RB event received:     : 591
Flush event sent          : 0
Flush event received:     : 0
Local FS event sent:      : 0
Remote FS event received: : 0
Local MS event sent:      : 0
Remote MS event received: : 0
```

### show protection-group ethernet-ring statistics detail (Specific Group)(MX Series Router)

```
user@host> show protection-group ethernet-ring statistics detail
```

```
Ethernet Ring statistics for PG Pg-1
RAPS event sent                : 1
RAPS event received            : 0
Local SF happened              : 0
Remote SF happened              : 0
NR event sent                  : 1
NR event received              : 0
NR-RB event sent               : 0
NR-RB event received           : 0
Flush event sent               : 0
Flush event received           : 0
Local FS event sent            : 0
Remote FS event received       : 0
Local MS event sent            : 0
Remote MS event received       : 0
Total number of FDB flush     : 0
Flush-logic triggered flush    : 0
Remote raps PDU received       : 0
Remote raps dropped due to guard-timer : 0
Invalid remote raps PDU dropped : 0
Raps dropped due to miscellaneous errors : 0
Local received raps PDU dropped : 0
```



## show protection-group ethernet-ring vlan

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show protection-group ethernet-ring vlan<br><brief   detail><br><group-name <i>group-name</i> >                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release Information</b>      | Command introduced in Junos OS Release 10.2.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description</b>              | On MX Series routers, display all data channel logical interfaces and the VLAN IDs controlled by a ring instance data channel.                                                                                                                                                                                                                                                                                                                                                        |
| <b>Options</b>                  | <b>brief   detail</b> —(Optional) Display the specified level of output.<br><br><b>group-name</b> —(Optional) Protection group for which to display details such as data channel interfaces, vlan, and bridge-domain. If you omit this optional field, details for all configured protection groups will be displayed.                                                                                                                                                                |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">show protection-group ethernet-ring aps on page 1812</a></li> <li>• <a href="#">show protection-group ethernet-ring data-channel on page 1822</a></li> <li>• <a href="#">show protection-group ethernet-ring interface on page 1826</a></li> <li>• <a href="#">show protection-group ethernet-ring node-state on page 1829</a></li> <li>• <a href="#">show protection-group ethernet-ring statistics on page 1833</a></li> </ul> |
| <b>List of Sample Output</b>    | <a href="#">show protection-group ethernet-ring vlan on page 1838</a><br><a href="#">show protection-group ethernet-ring vlan brief on page 1838</a><br><a href="#">show protection-group ethernet-ring vlan detail on page 1839</a><br><a href="#">show protection-group ethernet-ring vlan group-name vkm01 on page 1839</a>                                                                                                                                                        |
| <b>Output Fields</b>            | Table 154 on page 1837 lists the output fields for the <b>show protection-group ethernet-ring vlan</b> command. Output fields are listed in the approximate order in which they appear.                                                                                                                                                                                                                                                                                               |

**Table 154: show protection-group ethernet-ring vlan Output Fields**

| Field Name       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Interface</b> | Name of the interface configured for the Ethernet protection ring.                                                                                                                                                                                                                                                                                                                                                     |
| <b>Vlan</b>      | Name of the VLAN associated with the interface configured for the Ethernet protection ring.                                                                                                                                                                                                                                                                                                                            |
| <b>STP index</b> | The Spanning Tree Protocol (STP) index number used by each interface in an Ethernet ring. The STP index controls the forwarding behavior for a set of VLANs on a data channel on an Ethernet ring port. For multiple Ethernet ring instances on a physical ring port, there are multiple STP index numbers. Different ring instances will have different STP index numbers and may have different forwarding behavior. |

Table 154: show protection-group ethernet-ring vlan Output Fields (*continued*)

| Field Name    | Field Description                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------|
| Bridge Domain | Name of the bridge domain that is associated with the VLAN configured for the Ethernet protection ring. |

## Sample Output

### show protection-group ethernet-ring vlan

```
user@host> show protection-group ethernet-ring vlan
Ethernet ring IFBD parameters for protection group vkm01
```

| Interface | Vlan | STP Index | Bridge Domain       |
|-----------|------|-----------|---------------------|
| xe-5/0/2  | 1    | 78        | default-switch/bd1  |
| xe-2/2/0  | 1    | 79        | default-switch/bd1  |
| xe-5/0/2  | 2    | 78        | default-switch/bd2  |
| xe-2/2/0  | 2    | 79        | default-switch/bd2  |
| xe-5/0/2  | 3    | 78        | default-switch/bd3  |
| xe-2/2/0  | 3    | 79        | default-switch/bd3  |
| xe-5/0/2  | 4    | 78        | default-switch/bd4  |
| xe-2/2/0  | 4    | 79        | default-switch/bd4  |
| xe-5/0/2  | 5    | 78        | default-switch/bd5  |
| xe-2/2/0  | 5    | 79        | default-switch/bd5  |
| xe-5/0/2  | 6    | 78        | default-switch/bd6  |
| xe-2/2/0  | 6    | 79        | default-switch/bd6  |
| xe-5/0/2  | 7    | 78        | default-switch/bd7  |
| xe-2/2/0  | 7    | 79        | default-switch/bd7  |
| xe-5/0/2  | 8    | 78        | default-switch/bd8  |
| xe-2/2/0  | 8    | 79        | default-switch/bd8  |
| xe-5/0/2  | 9    | 78        | default-switch/bd9  |
| xe-2/2/0  | 9    | 79        | default-switch/bd9  |
| xe-5/0/2  | 10   | 78        | default-switch/bd10 |
| xe-2/2/0  | 10   | 79        | default-switch/bd10 |
| xe-5/0/2  | 11   | 78        | default-switch/bd11 |
| xe-2/2/0  | 11   | 79        | default-switch/bd11 |
| xe-5/0/2  | 12   | 78        | default-switch/bd12 |
| xe-2/2/0  | 12   | 79        | default-switch/bd12 |
| xe-5/0/2  | 13   | 78        | default-switch/bd13 |
| xe-2/2/0  | 13   | 79        | default-switch/bd13 |
| xe-5/0/2  | 14   | 78        | default-switch/bd14 |
| xe-2/2/0  | 14   | 79        | default-switch/bd14 |
| xe-5/0/2  | 15   | 78        | default-switch/bd15 |
| xe-2/2/0  | 15   | 79        | default-switch/bd15 |

### show protection-group ethernet-ring vlan brief

```
user@host> show protection-group ethernet-ring vlan brief
Ethernet ring IFBD parameters for protection group vkm01
```

| Interface | Vlan | STP Index | Bridge Domain      |
|-----------|------|-----------|--------------------|
| xe-5/0/2  | 1    | 78        | default-switch/bd1 |
| xe-2/2/0  | 1    | 79        | default-switch/bd1 |
| xe-5/0/2  | 2    | 78        | default-switch/bd2 |
| xe-2/2/0  | 2    | 79        | default-switch/bd2 |
| xe-5/0/2  | 3    | 78        | default-switch/bd3 |
| xe-2/2/0  | 3    | 79        | default-switch/bd3 |

|          |    |    |                     |
|----------|----|----|---------------------|
| xe-5/0/2 | 4  | 78 | default-switch/bd4  |
| xe-2/2/0 | 4  | 79 | default-switch/bd4  |
| xe-5/0/2 | 5  | 78 | default-switch/bd5  |
| xe-2/2/0 | 5  | 79 | default-switch/bd5  |
| xe-5/0/2 | 6  | 78 | default-switch/bd6  |
| xe-2/2/0 | 6  | 79 | default-switch/bd6  |
| xe-5/0/2 | 7  | 78 | default-switch/bd7  |
| xe-2/2/0 | 7  | 79 | default-switch/bd7  |
| xe-5/0/2 | 8  | 78 | default-switch/bd8  |
| xe-2/2/0 | 8  | 79 | default-switch/bd8  |
| xe-5/0/2 | 9  | 78 | default-switch/bd9  |
| xe-2/2/0 | 9  | 79 | default-switch/bd9  |
| xe-5/0/2 | 10 | 78 | default-switch/bd10 |
| xe-2/2/0 | 10 | 79 | default-switch/bd10 |
| xe-5/0/2 | 11 | 78 | default-switch/bd11 |
| xe-2/2/0 | 11 | 79 | default-switch/bd11 |
| xe-5/0/2 | 12 | 78 | default-switch/bd12 |
| xe-2/2/0 | 12 | 79 | default-switch/bd12 |
| xe-5/0/2 | 13 | 78 | default-switch/bd13 |
| xe-2/2/0 | 13 | 79 | default-switch/bd13 |
| xe-5/0/2 | 14 | 78 | default-switch/bd14 |
| xe-2/2/0 | 14 | 79 | default-switch/bd14 |
| xe-5/0/2 | 15 | 78 | default-switch/bd15 |
| xe-2/2/0 | 15 | 79 | default-switch/bd15 |

#### show protection-group ethernet-ring vlan detail

```
user@host> show protection-group ethernet-ring vlan detail
Ethernet ring IFBD parameters for protection group vkm01
```

```
Interface name      : xe-5/0/2
Vlan                : 1
STP index           : 78
Bridge Domain       : default-switch/bd1
```

```
Interface name      : xe-2/2/0
Vlan                : 1
STP index           : 79
Bridge Domain       : default-switch/bd1
```

```
Interface name      : xe-5/0/2
Vlan                : 2
STP index           : 78
Bridge Domain       : default-switch/bd2
```

```
Interface name      : xe-2/2/0
Vlan                : 2
STP index           : 79
Bridge Domain       : default-switch/bd2
```

```
Interface name      : xe-5/0/2
Vlan                : 3
STP index           : 78
Bridge Domain       : default-switch/bd3
```

#### show protection-group ethernet-ring vlan group-name vkm01

```
user@host> show protection-group ethernet-ring vlan vkm01

Ethernet ring IFBD parameters for protection group vkm01
```

| Interface | Vlan | STP Index | Bridge Domain       |
|-----------|------|-----------|---------------------|
| xe-5/0/2  | 16   | 80        | default-switch/bd16 |
| xe-2/2/0  | 16   | 81        | default-switch/bd16 |
| xe-5/0/2  | 17   | 80        | default-switch/bd17 |
| xe-2/2/0  | 17   | 81        | default-switch/bd17 |
| xe-5/0/2  | 18   | 80        | default-switch/bd18 |
| xe-2/2/0  | 18   | 81        | default-switch/bd18 |
| xe-5/0/2  | 19   | 80        | default-switch/bd19 |
| xe-2/2/0  | 19   | 81        | default-switch/bd19 |
| xe-5/0/2  | 20   | 80        | default-switch/bd20 |
| xe-2/2/0  | 20   | 81        | default-switch/bd20 |
| xe-5/0/2  | 21   | 80        | default-switch/bd21 |
| xe-2/2/0  | 21   | 81        | default-switch/bd21 |
| xe-5/0/2  | 22   | 80        | default-switch/bd22 |
| xe-2/2/0  | 22   | 81        | default-switch/bd22 |
| xe-5/0/2  | 23   | 80        | default-switch/bd23 |
| xe-2/2/0  | 23   | 81        | default-switch/bd23 |
| xe-5/0/2  | 24   | 80        | default-switch/bd24 |
| xe-2/2/0  | 24   | 81        | default-switch/bd24 |
| xe-5/0/2  | 25   | 80        | default-switch/bd25 |
| xe-2/2/0  | 25   | 81        | default-switch/bd25 |
| xe-5/0/2  | 26   | 80        | default-switch/bd26 |
| xe-2/2/0  | 26   | 81        | default-switch/bd26 |
| xe-5/0/2  | 27   | 80        | default-switch/bd27 |
| xe-2/2/0  | 27   | 81        | default-switch/bd27 |
| xe-5/0/2  | 28   | 80        | default-switch/bd28 |
| xe-2/2/0  | 28   | 81        | default-switch/bd28 |
| xe-5/0/2  | 29   | 80        | default-switch/bd29 |
| xe-2/2/0  | 29   | 81        | default-switch/bd29 |
| xe-5/0/2  | 30   | 80        | default-switch/bd30 |
| xe-2/2/0  | 30   | 81        | default-switch/bd30 |

## show security macsec connections (MX Series)

|                                 |                                                                                                                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show security macsec connections<br><interface <i>interface-name</i> >                                                                                                                                                      |
| <b>Release Information</b>      | Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                            |
| <b>Description</b>              | Display the status of the active MACsec connections on the router.                                                                                                                                                          |
| <b>Options</b>                  | <p><b>none</b>—Display MACsec connection information for all interfaces on the switch.</p> <p><b>interface <i>interface-name</i></b>—(Optional) Display MACsec connection information for the specified interface only.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                        |
| <b>List of Sample Output</b>    | <a href="#">show security macsec connections on page 1842</a>                                                                                                                                                               |
| <b>Output Fields</b>            | <a href="#">Table 155 on page 1841</a> lists the output fields for the <b>show security macsec connections</b> command. Output fields are listed in the approximate order in which they appear.                             |

Table 155: show security macsec connections Output Fields

| Field Name                  | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fields for Interface</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Interface name</b>       | Name of the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>CA name</b>              | <p>Name of the connectivity association.</p> <p>A connectivity association is named using the <b>connectivity-association</b> statement when you are enabling MACsec.</p>                                                                                                                                                                                                                                                                                    |
| <b>Cipher suite</b>         | Name of the cipher suite used for encryption.                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Encryption</b>           | <p>Encryption setting. Encryption is enabled when this output is <b>on</b> and disabled when this output is <b>off</b>.</p> <p>The encryption setting is set using the <b>no-encryption</b> statement in the connectivity association when using static connectivity association key (CAK) security mode and is set using the <b>encryption</b> statement in the secure channel when using static secure association key (SAK) or dynamic security mode.</p> |
| <b>Key server offset</b>    | <p>Offset setting.</p> <p>The offset is set using the <b>offset</b> statement when configuring the connectivity association when using static connectivity association key (CAK) or dynamic security mode or the secure channel when using static secure association key (SAK) security mode.</p>                                                                                                                                                            |

Table 155: show security macsec connections Output Fields (*continued*)

| Field Name            | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Include SCI</b>    | <p>SCI tagging. The SCI tag is included on packets in a secure channel when this output is <b>yes</b>, and not included on packets in a secure channel when this output is <b>no</b>.</p> <p>SCI tagging is automatically enabled on EX4300 switch interfaces that have enabled MACsec using static connectivity association key (CAK) or dynamic security mode. You can enable SCI tagging using the <b>include-sci</b> statement in the connectivity association.</p> |
| <b>Replay protect</b> | <p>Replay protection setting. Replay protection is enabled when this output is <b>on</b> and disabled when this output is <b>off</b>.</p> <p>You can enable replay protection using the <b>replay-protect</b> statement in the connectivity association.</p>                                                                                                                                                                                                            |
| <b>Replay window</b>  | <p>Replay protection window setting. This output is set to <b>0</b> when replay protection is disabled, and is the size of the replay window, in number of packets, when replay protection is enabled.</p> <p>The size of the replay window is configured using the <b>replay-window-size</b> statement in the connectivity association.</p>                                                                                                                            |

## Sample Output

### show security macsec connections

```

user@host> show security macsec connections
Interface name: xe-0/1/0
  CA name: CA1
  Cipher suite: GCM-AES-128   Encryption: on
  Key server offset: 0        Include SCI: no
  Replay protect: off         Replay window: 0

```

## show security macsec statistics (MX Series)

**Syntax** show security macsec statistics  
<brief | detail>  
<interface *interface-name*>

**Release Information** Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description** Display Media Access Control Security (MACsec) statistics.

**Options** **none**—Display MACsec statistics in brief form for all interfaces on the router.

**brief | detail**—(Optional) Display the specified level of output. Using the **brief** option is equivalent to entering the command with no options (the default). The **detail** option displays additional fields that are not visible in the **brief** output.



**NOTE:** The field names that only appear in this command output when you enter the **detail** option are mostly useful for debugging purposes by Juniper Networks support personnel.

**interface *interface-name***—(Optional) Display MACsec statistics for the specified interface only.

**Required Privilege Level** view

**List of Sample Output** [show security macsec statistics interface xe-0/1/0 detail on page 1845](#)

**Output Fields** [Table 156 on page 1843](#) lists the output fields for the **show security macsec statistics** command. Output fields are listed in the approximate order in which they appear.

The field names that appear in this command output only when you enter the **detail** option are mostly useful for debugging purposes by Juniper Networks support personnel. Those field names are, therefore, not included in this table.

**Table 156: show security macsec statistics Output Fields**

| Field Name                                   | Field Description                                                                                                                                                                                                                                             | Level of Output |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Interface name</b>                        | Name of the interface.                                                                                                                                                                                                                                        | All levels      |
| <b>Fields for Secure Channel transmitted</b> |                                                                                                                                                                                                                                                               |                 |
| <b>Encrypted packets</b>                     | Total number of packets transmitted out of the interface in the secure channel that were secured and encrypted using MACsec.<br><br>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK). | All levels      |

Table 156: show security macsec statistics Output Fields (*continued*)

| Field Name                                       | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                 | Level of Output |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Encrypted bytes</b>                           | <p>Total number of bytes transmitted out of the interface in the secure channel that were secured and encrypted using MACsec.</p> <p>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</p>                                                                                                                                                                | All levels      |
| <b>Protected packets</b>                         | <p>Total number of packets transmitted out of the interface in the secure channel that were secured but not encrypted using MACsec.</p> <p>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</p>                                                                                                                                                          | All levels      |
| <b>Protected bytes</b>                           | <p>Total number of bytes transmitted out of the interface in the secure channel that were secured but not encrypted using MACsec.</p> <p>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</p>                                                                                                                                                            | All levels      |
| <b>Fields for Secure Association transmitted</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| <b>Encrypted packets</b>                         | <p>Total number of packets transmitted out of the interface in the connectivity association that were secured and encrypted using MACsec.</p> <p>The total includes the data packets transmitted in the secure channel and secured using a SAK and the control packets secured using a connectivity association key (CAK).</p>                                                                                                    | All levels      |
| <b>Protected packets</b>                         | <p>Total number of packets transmitted out of the interface in the connectivity association that were secured but not encrypted using MACsec.</p> <p>The total includes the data packets transmitted in the secure channel and secured using a SAK and the control packets secured using a connectivity association key (CAK).</p>                                                                                                | All levels      |
| <b>Fields for Secure Channel received</b>        |                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| <b>Accepted packets</b>                          | <p>The number of received packets that have been accepted by the secure channel on the interface. The secure channel is used to send all data plane traffic on a MACsec-enabled link.</p> <p>A packet is considered accepted for this counter when it has been received by this interface and it has passed the MACsec integrity check.</p> <p>This counter increments for traffic that is and is not encrypted using MACsec.</p> | All levels      |
| <b>Validated bytes</b>                           | <p>The number of bytes that have been validated by the MACsec integrity check and received on the secure channel on the interface. The secure channel is used to send all data plane traffic on a MACsec-enabled link.</p> <p>This counter does not increment when MACsec encryption is disabled.</p>                                                                                                                             | All levels      |



Table 156: show security macsec statistics Output Fields (*continued*)

| Field Name                                    | Field Description                                                                                                                                                                                                                                                                                                                                                                                     | Level of Output |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Decrypted bytes</b>                        | <p>The number of bytes received in the secure channel on the interface that have been decrypted. The secure channel is used to send all data plane traffic on a MACsec-enabled link.</p> <p>An encrypted byte has to be decrypted before it can be received on the receiving interface. The decrypted bytes counter is incremented for received traffic that was encrypted using MACsec.</p>          | All levels      |
| <b>Fields for Secure Association received</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
| <b>Accepted packets</b>                       | <p>The number of received packets that have been accepted in the connectivity association on the interface. The counter includes all control and data plane traffic accepted on the interface.</p> <p>A packet is considered accepted for this counter when it has been received by this interface and it has passed the MACsec integrity check.</p>                                                  | All levels      |
| <b>Validated bytes</b>                        | <p>The number of bytes that have been validated by the MACsec integrity check and received on the connectivity association on the interface. The counter includes all control and data plane traffic accepted on the interface.</p> <p>This counter does not increment when MACsec encryption is disabled.</p>                                                                                        | All levels      |
| <b>Decrypted bytes</b>                        | <p>The number of bytes received in the connectivity association on the interface that have been decrypted. The counter includes all control and data plane traffic accepted on the interface.</p> <p>An encrypted byte has to be decrypted before it can be received on the receiving interface. The decrypted bytes counter is incremented for received traffic that was encrypted using MACsec.</p> | All levels      |

## Sample Output

### show security macsec statistics interface xe-0/1/0 detail

```
user@host> show security macsec statistics interface xe-0/1/0 detail
```

```
Interface name: xe-0/1/0
Secure Channel transmitted
  Encrypted packets: 123858
  Encrypted bytes:   32190903
  Protected packets: 0
  Protected bytes:   0
Secure Association transmitted
  Encrypted packets: 123858
  Protected packets: 0
Secure Channel received
  Accepted packets: 123877
  Validated bytes:   0
  Decrypted bytes:   32196238
Secure Association received
  Accepted packets: 123877
```

```
Validated bytes: 0
Decrypted bytes: 32196238
Error and debug
Secure Channel transmitted packets
  Untagged: 0, Too long: 0
Secure Channel received packets
  Control: 0, Tagged miss: 3202804
  Untagged hit: 0, Untagged: 0
  No tag: 0, Bad tag: 0
  Unknown SCI: 0, No SCI: 0
  Control pass: 0, Control drop: 0
  Uncontrol pass: 123877, Uncontrol drop: 0
  Hit dropped: 0, Invalid accept: 0
  Late drop: 0, Delayed accept: 0
  Unchecked: 0, Not valid drop: 0
  Not using SA drop: 0, Unused SA accept: 0
```

## show security mka sessions (MX Series)

|                                 |                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show security mka sessions<br><interface <i>interface-name</i> >                                                                                                          |
| <b>Release Information</b>      | Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                          |
| <b>Description</b>              | Display MACsec Key Agreement (MKA) session information.                                                                                                                   |
| <b>Options</b>                  | <ul style="list-style-type: none"> <li><b>interface <i>interface-name</i></b>—(Optional) Display the MKA session information for the specified interface only.</li> </ul> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                      |
| <b>List of Sample Output</b>    | <a href="#">show security mka sessions on page 1848</a>                                                                                                                   |
| <b>Output Fields</b>            | Table 157 on page 1847 lists the output fields for the <b>show security mka sessions</b> command. Output fields are listed in the approximate order in which they appear. |

Table 157: show security mka sessions Output Fields

| Field Name          | Field Description                                                                                                                                    |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interface name      | Name of the interface.                                                                                                                               |
| Member identifier   | Name of the member identifier.                                                                                                                       |
| CAK name            | Name of the Connectivity Association Key (CAK).<br>The CAK is configured using the <b>cak</b> keyword when configuring the pre-shared key.           |
| Transmit interval   | The transmit interval.                                                                                                                               |
| Outbound SCI        | Name of the outbound secure channel identifier.                                                                                                      |
| Message number      | Number of the last data message.                                                                                                                     |
| Key number          | Key number.                                                                                                                                          |
| Key server          | Key server status.<br>The switch is the key server when this output is <b>yes</b> . The switch is not the key server when this output is <b>no</b> . |
| Key server priority | The key server priority.<br>The key server priority can be set using the <b>key-server-priority</b> statement.                                       |
| Latest SAK AN       | Name of the latest secure association key (SAK) association number.                                                                                  |
| Latest SAK KI       | Name of the latest secure association key (SAK) key identifier.                                                                                      |

Table 157: show security mka sessions Output Fields (*continued*)

| Field Name           | Field Description                                   |
|----------------------|-----------------------------------------------------|
| Fields for Peer list |                                                     |
| Member identifier    | Name of the member identifier.                      |
| Hold time            | Hold time, in seconds.                              |
| Message number       | Number of the last data message                     |
| SCI                  | Name of the secure channel identifier.              |
| Lowest acceptable PN | Number of the lowest acceptable packet number (PN). |

## Sample Output

### show security mka sessions

```
user@host> show security mka sessions
```

```
Interface name: xe-0/1/0
Member identifier: OCCBEE42F8778300F8D0C1DC
CAK name: 1234567890
Transmit interval: 2000(ms)
Outbound SCI: 2C:6B:F5:9D:4B:1B/1
Message number: 1526465      Key number: 0
Key server: no              Key server priority: 15
Latest SAK AN: 0            Latest SAK KI: 4F18CE25228178FD15976E4C/1
Previous SAK AN: 0          Previous SAK KI: 000000000000000000000000/0
Peer list
1. Member identifier: 4F18CE25228178FD15976E4C (live)
   Message number: 1526484 Hold time: 14500 (ms)
   SCI: 2C:6B:F5:9D:3A:1B/1
   Lowest acceptable PN: 121198
```

## show security mka statistics (MX Series)

|                                 |                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | show security mka statistics<br><interface <i>interface-name</i> >                                                                                                                                                               |
| <b>Release Information</b>      | Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.                                                                                                                                                 |
| <b>Description</b>              | Display MACsec Key Agreement (MKA) protocol statistics.<br><br>The output for this command does not include statistics for MACsec data traffic. For MACsec data traffic statistics, see <i>show security macsec statistics</i> . |
| <b>Options</b>                  | <ul style="list-style-type: none"> <li><b>interface <i>interface-name</i></b>—(Optional) Display the MKA information for the specified interface only.</li> </ul>                                                                |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                             |
| <b>List of Sample Output</b>    | <a href="#">show security mka statistics on page 1850</a>                                                                                                                                                                        |
| <b>Output Fields</b>            | <a href="#">Table 158 on page 1849</a> lists the output fields for the <b>show security mka statistics</b> command. Output fields are listed in the approximate order in which they appear.                                      |

**Table 158: show security mka statistics Output Fields**

| Field Name                                  | Field Description                                                                                                                                                                                                                                                                                           |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Received packets</b>                     | <p>Number of received MKA control packets.</p> <p>This counter increments for received MKA control packets only. This counter does not increment when data packets are received.</p>                                                                                                                        |
| <b>Transmitted packets</b>                  | <p>Number of transmitted MKA packets</p> <p>This counter increments for transmitted MKA control packets only. This counter does not increment when data packets are transmitted.</p>                                                                                                                        |
| <b>Version mismatch packets</b>             | Number of version mismatch packets.                                                                                                                                                                                                                                                                         |
| <b>CAK mismatch packets</b>                 | <p>Number of Connectivity Association Key (CAK) mismatch packets.</p> <p>This counter increments when the connectivity association key (CAK) and connectivity association key name (CKN), which are user-configured values that have to match to enable MACsec, do not match for an MKA control packet.</p> |
| <b>ICV mismatch packets</b>                 | <p>Number of ICV mismatched packets.</p> <p>This counter increments when the connectivity association key (CAK) value does not match on both ends of a MACsec-secured Ethernet link.</p>                                                                                                                    |
| <b>Duplicate message identifier packets</b> | Number of duplicate message identifier packets.                                                                                                                                                                                                                                                             |
| <b>Duplicate message number packets</b>     | Number of duplicate message number packets.                                                                                                                                                                                                                                                                 |

Table 158: show security mka statistics Output Fields *(continued)*

| Field Name                          | Field Description                                  |
|-------------------------------------|----------------------------------------------------|
| Duplicate address packets           | Number of duplicate source MAC address packets.    |
| Invalid destination address packets | Number of invalid destination MAC address packets. |
| Formatting error packets            | Number of formatting error packets.                |
| Old Replayed message number packets | Number of old replayed message number packets.     |

## Sample Output

### show security mka statistics

```
user@host> show security mka statistics

Received packets:          1525844
Transmitted packets:       1525841
Version mismatch packets:  0
CAK mismatch packets:      0
ICV mismatch packets:      0
Duplicate message identifier packets: 0
Duplicate message number packets: 0
Duplicate address packets:  0
Invalid destination address packets: 0
Formatting error packets:   0
Old Replayed message number packets: 0
```

## show vrrp

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre>show vrrp &lt;brief   detail   extensive   summary&gt; &lt;interface <i>interface-name</i> &lt;group number&gt;&gt; &lt;logical-system (all   <i>logical-system-name</i>)&gt; &lt;nsr&gt; &lt;track &lt;interfaces&gt;&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Release Information</b>      | <p>Command introduced before Junos OS Release 7.4.</p> <p><b>nsr</b> option added in Junos OS Release 13.2.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | Display status information about Virtual Router Redundancy Protocol (VRRP) groups.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Options</b>                  | <p><b>none</b>—(Same as <b>brief</b>) Display brief status information about all VRRP interfaces.</p> <p><b>brief   detail   extensive   summary</b>—(Optional) Display the specified level of output.</p> <p><b>interface <i>interface-name</i> &lt;group number&gt;</b>—(Optional) Display information and status about the specified VRRP interface and, optionally, the group number.</p> <p><b>logical-system (all   <i>logical-system-name</i>)</b>—(Optional) Perform this operation on all logical systems or on a particular logical system.</p> <p><b>nsr</b>—(Optional) Display state replication information when graceful Routing Engine switchover (GRES) with nonstop active routing (NSR) is configured. Use only on the backup Routing Engine.</p> <p><b>track &lt;interfaces&gt;</b>—(Optional) Display information and status about VRRP track interfaces.</p> |
| <b>Required Privilege Level</b> | view                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Related Documentation</b>    | <ul style="list-style-type: none"> <li>• <a href="#">clear vrrp</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>List of Sample Output</b>    | <p><a href="#">show vrrp on page 1857</a></p> <p><a href="#">show vrrp brief on page 1857</a></p> <p><a href="#">show vrrp detail (IPv6) on page 1857</a></p> <p><a href="#">show vrrp detail (Route Track) on page 1858</a></p> <p><a href="#">show vrrp detail (Route Track) on page 1858</a></p> <p><a href="#">show vrrp extensive on page 1858</a></p> <p><a href="#">show vrrp interface on page 1859</a></p> <p><a href="#">show vrrp nsr on page 1860</a></p> <p><a href="#">show vrrp summary on page 1861</a></p> <p><a href="#">show vrrp track detail on page 1861</a></p> <p><a href="#">show vrrp track summary on page 1861</a></p>                                                                                                                                                                                                                                |
| <b>Output Fields</b>            | <p><a href="#">Table 159 on page 1852</a> lists the output fields for the <b>show vrrp</b> command. Output fields are listed in the approximate order in which they appear</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Table 159: show vrrp Output Fields

| Field Name                                 | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Level of Output                     |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Interface</b>                           | Name of the logical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>brief extensive none summary</b> |
| <b>Interface index</b>                     | Physical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>extensive</b>                    |
| <b>Groups</b>                              | Total number of VRRP groups configured on the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>extensive</b>                    |
| <b>Active</b>                              | Total number of VRRP groups that are active (that is, whose interface state is either up or down).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>extensive</b>                    |
| <b>Interface VRRP PDU statistics</b>       | Non-errored statistics for the logical interface: <ul style="list-style-type: none"> <li>• <b>Advertisement sent</b>—Number of VRRP advertisement protocol data units (PDUs) that the interface has transmitted.</li> <li>• <b>Advertisement received</b>—Number of VRRP advertisement PDUs received by the interface.</li> <li>• <b>Packets received</b>—Number of VRRP packets received for VRRP groups on the interface.</li> <li>• <b>No group match received</b>—Number of VRRP packets received for VRRP groups that do not exist on the interface.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>extensive</b>                    |
| <b>Interface VRRP PDU error statistics</b> | Errored statistics for the logical interface: <ul style="list-style-type: none"> <li>• <b>Invalid IPAH next type received</b>—Number of packets received that use the IP Authentication Header protocol (IPAH) and that do not encapsulate VRRP packets.</li> <li>• <b>Invalid VRRP ttl value received</b>—Number of packets received whose IP time-to-live (TTL) value is not 255.</li> <li>• <b>Invalid VRRP version received</b>—Number of packets received whose VRRP version is not 2.</li> <li>• <b>Invalid VRRP pdu type received</b>—Number of packets received whose VRRP PDU type is not 1.</li> <li>• <b>Invalid VRRP authentication type received</b>—Number of packets received whose VRRP authentication is not none, simple, or md5.</li> <li>• <b>Invalid VRRP IP count received</b>—Number of packets received whose VRRP IP count exceeds 8.</li> <li>• <b>Invalid VRRP checksum received</b>—Number of packets received whose VRRP checksum does not match the calculated one.</li> </ul> | <b>extensive</b>                    |
| <b>Physical interface</b>                  | Name of the physical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>detail extensive</b>             |
| <b>Unit</b>                                | Logical unit number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>All levels</b>                   |
| <b>Address</b>                             | Address of the physical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>brief detail extensive none</b>  |
| <b>Index</b>                               | Physical interface index number, which reflects its initialization sequence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>detail extensive</b>             |
| <b>SNMP ifindex</b>                        | SNMP index number for the physical interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>detail extensive</b>             |



Table 159: show vrrp Output Fields (*continued*)

| Field Name                   | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Level of Output              |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| VRRP-Traps                   | Status of VRRP traps: <b>Enabled</b> or <b>Disabled</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | detail extensive             |
| VRRP-Version                 | VRRP version: <b>2</b> or <b>3</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | detail extensive             |
| Type and Address             | Identifier for the address and the address itself: <ul style="list-style-type: none"> <li><b>lcl</b>—Configured local interface address.</li> <li><b>mas</b>—Address of the master virtual router. This address is displayed only when the local interface is acting as a backup router.</li> <li><b>vip</b>—Configured virtual IP addresses.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                    | brief none summary           |
| Interface state or Int state | State of the physical interface: <ul style="list-style-type: none"> <li><b>down</b>—The device is present and the link is unavailable.</li> <li><b>not present</b>—The interface is configured, but no physical device is present.</li> <li><b>unknown</b>—The VRRP process has not had time to query the kernel about the state of the interface.</li> <li><b>up</b>—The device is present and the link is established.</li> </ul>                                                                                                                                                                                                                                                                                                                                                         | brief extensive none summary |
| Group                        | VRRP group number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | brief extensive none summary |
| State                        | The state of the interface on which VRRP is running: <ul style="list-style-type: none"> <li><b>backup</b>—The interface is acting as the backup router interface.</li> <li><b>bringup</b>—VRRP is just starting and the physical device is not yet present.</li> <li><b>idle</b>—VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established.</li> <li><b>init</b>—VRRP is initializing.</li> <li><b>master</b>—The interface is acting as the master router interface.</li> <li><b>master(ISSU)</b>—The master router interface is going through a unified in-service software upgrade.</li> <li><b>transition</b>—The interface is changing between being the backup and being the master router.</li> </ul> | extensive                    |
| VRRP Mode                    | If the interface inherits its state and configuration from the active VRRP group, or if it is part of the active VRRP group. <ul style="list-style-type: none"> <li>Active—Part of the active VRRP group</li> <li>Inherit—Inherits state and configuration from the active VRRP group.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | detail extensive             |
| Priority                     | Configured VRRP priority for the interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | detail extensive             |
| Advertisement interval       | Configured VRRP advertisement interval.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | detail extensive             |
| Authentication type          | Configured VRRP authentication type: <b>none</b> , <b>simple</b> , or <b>md5</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | detail extensive             |

Table 159: show vrrp Output Fields (*continued*)

| Field Name                     | Field Description                                                                                                                                                                                                                                                                                                                                 | Level of Output         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Advertisement Threshold</b> | <p>A value from 1 through 15, used for setting the time when a peer should be considered down.</p> <ul style="list-style-type: none"> <li>The time a peer is considered down is equal to the advertisement-threshold multiplied by the advertisement-interval.</li> <li>(advertisement-threshold *advertisement-interval) = Peer down.</li> </ul> | <b>detail extensive</b> |
| <b>Computed Send Rate</b>      | <p>How many protocol data units (PDUs) are generated per second.</p> <p>Based on the number of instances and the advertisement interval.</p>                                                                                                                                                                                                      | <b>detail extensive</b> |
| <b>Preempt</b>                 | Whether preemption is allowed on the interface: <b>yes</b> or <b>no</b> .                                                                                                                                                                                                                                                                         | <b>detail extensive</b> |
| <b>Accept-data mode</b>        | Whether the interface is configured to accept packets destined for the virtual IP address: <b>yes</b> or <b>no</b> .                                                                                                                                                                                                                              | <b>detail extensive</b> |
| <b>VIP count</b>               | Number of virtual IP addresses that have been configured on the interface.                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>VIP</b>                     | List of virtual IP addresses configured on the interface.                                                                                                                                                                                                                                                                                         | <b>detail extensive</b> |
| <b>Advertisement timer</b>     | How long, in seconds, until the advertisement timer expires.                                                                                                                                                                                                                                                                                      | <b>detail extensive</b> |
| <b>Master router</b>           | IP address of the interface that is acting as the master. If the VRRP interface is down, the output is <b>N/A</b> .                                                                                                                                                                                                                               | <b>detail extensive</b> |
| <b>Virtual router uptime</b>   | How long, in seconds, that the virtual router has been up.                                                                                                                                                                                                                                                                                        | <b>detail extensive</b> |
| <b>Master router uptime</b>    | How long, in seconds, that the master route has been up.                                                                                                                                                                                                                                                                                          | <b>detail extensive</b> |
| <b>Virtual MAC</b>             | MAC address associated with the virtual IP address.                                                                                                                                                                                                                                                                                               | <b>detail extensive</b> |
| <b>Tracking</b>                | Whether tracking is <b>enabled</b> or <b>disabled</b> .                                                                                                                                                                                                                                                                                           | <b>detail extensive</b> |
| <b>Current priority</b>        | Current operational priority for being the VRRP master.                                                                                                                                                                                                                                                                                           | <b>detail extensive</b> |
| <b>Configured priority</b>     | Configured base priority for being the VRRP master.                                                                                                                                                                                                                                                                                               | <b>detail extensive</b> |
| <b>Priority hold-time</b>      | Minimum time interval, in seconds, between successive changes to the current priority. <b>Disabled</b> indicates no minimum interval.                                                                                                                                                                                                             | <b>detail extensive</b> |
| <b>Remaining-time</b>          | ( <b>track</b> option only) Displays the time remaining in the priority hold-time interval.                                                                                                                                                                                                                                                       | <b>detail</b>           |
| <b>Interface tracking</b>      | Whether interface tracking is enabled or disabled. When enabled, the output also displays the number of tracked interfaces.                                                                                                                                                                                                                       | <b>detail extensive</b> |

Table 159: show vrrp Output Fields (*continued*)

| Field Name                         | Field Description                                                                                                                                                                                                                                                                                              | Level of Output         |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Interface/Tracked interface</b> | Name of the tracked interface.                                                                                                                                                                                                                                                                                 | <b>detail extensive</b> |
| <b>Int state/Interface state</b>   | Current operational state of the tracked interface: <b>up</b> or <b>down</b> .                                                                                                                                                                                                                                 | <b>detail extensive</b> |
| <b>Int speed/Speed</b>             | Current operational speed, in bits per second, of the tracked interface.                                                                                                                                                                                                                                       | <b>detail extensive</b> |
| <b>Incurred priority cost</b>      | Operational priority cost incurred due to the state and speed of this tracked interface. This cost is applied to the configured priority to obtain the current priority.                                                                                                                                       | <b>detail extensive</b> |
| <b>Threshold</b>                   | Speed below which the corresponding priority cost is incurred. In other words, when the speed of the interface drops below the threshold speed, the corresponding priority cost is incurred.<br><br>An entry of <b>down</b> means that the corresponding priority cost is incurred when the interface is down. | <b>detail extensive</b> |
| <b>Route tracking</b>              | Whether route tracking is enabled or disabled. When enabled, the output also displays the number of tracked routes.                                                                                                                                                                                            | <b>detail extensive</b> |
| <b>Route count</b>                 | The number of routes being tracked.                                                                                                                                                                                                                                                                            | <b>detail extensive</b> |
| <b>Route</b>                       | The IP address of the route being tracked.                                                                                                                                                                                                                                                                     | <b>detail extensive</b> |
| <b>VRF name</b>                    | The VPN routing and forwarding (VRF) routing instance that the tracked route is in.                                                                                                                                                                                                                            | <b>detail extensive</b> |
| <b>Route state</b>                 | The state of the route being tracked: <b>up</b> , <b>down</b> , or <b>unknown</b> .                                                                                                                                                                                                                            | <b>detail extensive</b> |
| <b>Priority cost</b>               | Configured priority cost. This value is incurred when the interface speed drops below the corresponding threshold or when the tracked route goes down.                                                                                                                                                         | <b>detail extensive</b> |
| <b>Active</b>                      | Whether the threshold is active (*). If the threshold is active, the corresponding priority cost is incurred.                                                                                                                                                                                                  | <b>detail extensive</b> |
| <b>Group VRRP PDU statistics</b>   | Number of VRRP advertisements sent and received by the group.                                                                                                                                                                                                                                                  | <b>extensive</b>        |

Table 159: show vrrp Output Fields (*continued*)

| Field Name                        | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Level of Output    |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Group VRRP PDU error statistics   | <p>Errored statistics for the VRRP group:</p> <ul style="list-style-type: none"> <li>• <b>Bad authentication type received</b>—Number of VRRP PDUs received with an invalid authentication type. The received authentication can be <b>none</b>, <b>simple</b>, or <b>md5</b> and must be the same for all routers in the VRRP group.</li> <li>• <b>Bad password received</b>—Number of VRRP PDUs received with an invalid key (password). The password for simple authentication must be the same for all routers in the VRRP group</li> <li>• <b>Bad MD5 digest received</b>—Number of VRRP PDUs received for which the MD5 digest computed from the VRRP PDU differs from the digest expected by the VRRP instance configured on the router.</li> <li>• <b>Bad advertisement timer received</b>—Number of VRRP PDUs received with an advertisement time interval that is inconsistent with the one in use among the routers in the VRRP group.</li> <li>• <b>Bad VIP count received</b>—Number of VRRP PDUs whose virtual IP address counts differ from the count that has been configured on the VRRP instance.</li> <li>• <b>Bad VIPADDR received</b>—Number of VRRP PDUs whose virtual IP addresses differ from the list of virtual IP addresses configured on the VRRP instance.</li> </ul> | extensive          |
| Group state transition statistics | <p>State transition statistics for the VRRP group:</p> <ul style="list-style-type: none"> <li>• <b>Idle to master transitions</b>—Number of times that the VRRP instance transitioned from the idle state to the master state.</li> <li>• <b>Idle to backup transitions</b>—Number of times that the VRRP instance transitioned from the idle state to the backup state.</li> <li>• <b>Backup to master transitions</b>—Number of times that the VRRP instance transitioned from the backup state to the master state.</li> <li>• <b>Master to backup transitions</b>—Number of times that the VRRP instance transitioned from the master state to the backup state.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | extensive          |
| VR state                          | <p>The state of the VRRP:</p> <ul style="list-style-type: none"> <li>• <b>backup</b>—The interface is acting as the backup router interface.</li> <li>• <b>bringup</b>—VRRP is just starting, and the physical device is not yet present.</li> <li>• <b>idle</b>—VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established.</li> <li>• <b>init</b>—VRRP is initializing.</li> <li>• <b>master</b>—The interface is acting as the master router interface.</li> <li>• <b>transition</b>—The interface is changing between being the backup and being the master router.</li> </ul> <p><b>NOTE:</b> When show vrrp nsr is used on the backup Routing Engine, it displays the current VRRP state on the master Routing Engine, which is the future VRRP state for the backup Routing Engine. Do not use on the master Routing Engine.</p>                                                                                                                                                                                                                                                                                                                                                                              | brief none summary |

Table 159: show vrrp Output Fields (*continued*)

| Field Name | Field Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Level of Output   |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| NSR        | <p>VRRP nonstop active routing is enabled for the configured VRRP group: <b>yes</b> or <b>no</b>.</p> <p><b>NOTE:</b> A <b>yes</b> value means that the new master Routing Engine will immediately start with the VRRP State value from the original master Routing Engine.</p> <p>A <b>no</b> value means that the VRRP session will:</p> <ul style="list-style-type: none"> <li>• Start afresh.</li> <li>• Go through asilent startup period.</li> <li>• Move to a backup state.</li> <li>• Wait for the D Timer to run out before becoming the master (only if the master has not been configured already).</li> </ul> | <b>brief</b> none |
| RPD-NSR    | The routing options have been set to nonstop active routing: <b>yes</b> or <b>no</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>brief</b> none |
| Timer      | <p>VRRP timer information:</p> <ul style="list-style-type: none"> <li>• <b>A</b>—How long, in seconds, until the advertisement timer expires.</li> <li>• <b>D</b>—How long, in seconds, until the Master is Down timer expires.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                | <b>brief</b> none |

## Sample Output

### show vrrp

```

user@host> show vrrp
Interface      State      Group   VR state  Timer   Type   Address
fe-0/0/0.121   up         1       master    A 1.052  1c1    fec0::12:1:1:1
                                     vip     fe80::12:1:1:99
                                     vip     fec0::12:1:1:99
fe-0/0/2.131   up         1       master    A 0.364  1c1    fec0::13:1:1:1
                                     vip     fe80::13:1:1:99
                                     vip     fec0::13:1:1:99

```

### show vrrp brief

The output for the **show vrrp brief** command is identical to that for the **show vrrp** command. For sample output, see [show vrrp on page 1857](#).

### show vrrp detail (IPv6)

```

user@host> show vrrp detail
Physical interface: fe-0/0/0, Unit: 121, Vlan-id: 212, Address: fec0::12:1:1:1/120

Index: 67, SNMP ifIndex: 45, VRRP-Traps: enabled
Interface state: up, Group: 1, State: master, VRRP Mode: Active
Priority: 200, Advertisement interval: 1, Authentication type: none
Advertisement threshold: 3, Computed send rate: 0
Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: fe80::12:1:1:99,

```

```

fec0::12:1:1:99
  Advertisement timer: 1.121s, Master router: fe80::12:1:1:1
  Virtual router uptime: 00:03:47, Master router uptime: 00:03:41
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled

Physical interface: fe-0/0/2, Unit: 131, Vlan-id: 213, Address: fec0::13:1:1:120

  Index: 69, SNMP ifIndex: 47, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: fe80::13:1:1:99,
fec0::13:1:1:99
  Advertisement timer: 0.327s, Master router: fe80::13:1:1:1
  Virtual router uptime: 00:03:47, Master router uptime: 00:03:41
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled

```

### show vrrp detail (Route Track)

```

user@host> show vrrp detail
Physical interface: ge-0/0/0, Unit: 1, Vlan-id: 1, Address: 101.1.1.1/24
  Index: 324, SNMP ifIndex: 623, VRRP-Traps: enabled, VRRP-Version: 2
  Interface state: up, Group: 1, State: master(ISSU), VRRP Mode: Active
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Advertisement threshold: 3, Computed send rate: 0
  Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 101.1.1.3
  Advertisement Timer: 0.469s, Master router: 101.1.1.1
  Virtual router uptime: 00:02:10, Master router uptime: 00:02:05
  Virtual Mac: 00:00:5e:00:01:01
  Tracking: disabled

```

### show vrrp detail (Route Track)

```

user@host> show vrrp detail
Physical interface: ge-1/2/0, Unit: 0, Address: 30.30.30.30/24
  Index: 67, SNMP ifIndex: 379, VRRP-Traps: enabled, VRRP-Version: 2
  Interface state: up, Group: 100, State: master
  Priority: 150, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 30.30.30.100
  Advertisement timer: 1.218s, Master router: 30.30.30.30
  Virtual router uptime: 00:04:28, Master router uptime: 00:00:13
  Virtual MAC: 00:00:5e:00:01:64
  Tracking: enabled
    Current priority: 150, Configured priority: 150
    Priority hold-time: disabled
    Interface tracking: disabled
    Route tracking: enabled, Route count: 1
      Route          VRF name    Route state  Priority cost
      192.168.40.0/22 default      up           30

```

### show vrrp extensive

```

user@host> show vrrp extensive
Interface: ge-2/0/0.0, Interface index :65539, Groups: 1, Active :1
  Interface VRRP PDU statistics
    Advertisement sent           :0
    Advertisement received       :0
    Packets received              :0
    No group match received       :0
  Interface VRRP PDU error statistics
    Invalid IPAH next type received :0

```

```

Invalid VRRP TTL value received      :0
Invalid VRRP version received        :0
Invalid VRRP PDU type received       :0
Invalid VRRP authentication type received:0
Invalid VRRP IP count received       :0
Invalid VRRP checksum received       :0

```

```

Physical interface: ge-2/0/0, Unit: 0, Address: 10.10.10.1/24
Index: 65539, SNMP ifIndex: 648, VRRP-Traps: enabled, VRRP-Version: 3
Interface state: up, Group: 1, State: backup, VRRP Mode: Active
Priority: 100, Advertisement interval: 1, Authentication type: none
Advertisement threshold: 3, Computed send rate: 0
Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 10.10.10.2
Dead timer: 3.078s, Master priority: 0, Master router: 10.10.10.1
Virtual router uptime: 00:00:04
Tracking: disabled
Group VRRP PDU statistics
  Advertisement sent                  :0
  Advertisement received              :0
Group VRRP PDU error statistics
  Bad authentication Type received    :0
  Bad password received               :0
  Bad MD5 digest received             :0
  Bad advertisement timer received    :0
  Bad VIP count received              :0
  Bad VIPADDR received               :0
Group state transition statistics
  Idle to master transitions          :0
  Idle to backup transitions          :1
  Backup to master transitions        :0
  Master to backup transitions        :0

```

### show vrrp interface

```

user@host> show vrrp interface ge-0/0/0.1
Interface: ge-0/0/0.1, Interface index :324, Groups: 2, Active :2
  Interface VRRP PDU statistics
    Advertisement sent                :39
    Advertisement received            :0
    Packets received                  :0
    No group match received           :0
  Interface VRRP PDU error statistics
    Invalid IPAH next type received   :0
    Invalid VRRP TTL value received   :0
    Invalid VRRP version received     :0
    Invalid VRRP PDU type received    :0
    Invalid VRRP authentication type received:0
    Invalid VRRP IP count received    :0
    Invalid VRRP checksum received    :0

Physical interface: ge-0/0/0, Unit: 1, Vlan-id: 1, Address: 101.1.1.1/24
Index: 324, SNMP ifIndex: 623, VRRP-Traps: enabled, VRRP-Version: 2
Interface state: up, Group: 1, State: master(ISSU), VRRP Mode: Active
Advertisement threshold: 3, Computed send rate: 0
Priority: 200, Advertisement interval: 1, Authentication type: none
Advertisement threshold: 3, Computed send rate: 0
Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 101.1.1.3
Advertisement Timer: 0.619s, Master router: 101.1.1.1
Virtual router uptime: 00:00:22, Master router uptime: 00:00:17
Virtual Mac: 00:00:5e:00:01:01
Tracking: disabled

```

```

Group VRRP PDU statistics
  Advertisement sent           :20
  Advertisement received       :0
Group VRRP PDU error statistics
  Bad authentication Type received :0
  Bad password received          :0
  Bad MD5 digest received        :0
  Bad advertisement timer received :0
  Bad VIP count received         :0
  Bad VIPADDR received          :0
Group state transition statistics
  Idle to master transitions      :0
  Idle to backup transitions     :1
  Backup to master transitions    :1
  Master to backup transitions   :0
Interface: fe-0/0/0.121, Interface index: 67, Groups: 1, Active : 1
Interface VRRP PDU statistics
  Advertisement sent           :      205
  Advertisement received       :         0
  Packets received             :         0
  No group match received      :         0
Interface VRRP PDU error statistics
  Invalid IPAH next type received :         0
  Invalid VRRP TTL value received :         0
  Invalid VRRP version received  :         0
  Invalid VRRP PDU type received :         0
  Invalid VRRP authentication type received:         0
  Invalid VRRP IP count received :         0
  Invalid VRRP checksum received :         0

```

### show vrrp nsr

This command is similar to **show vrrp**. Here, the **VR state** column displays the current VRRP state on the master Routing Engine, which is the future VRRP state for the backup Routing Engine. Do not use on the master Routing Engine.

NSR is yes if VRRP nonstop active routing is enabled for the configured VRRP group.

RPD-NSR is yes if the routing options have been set to nonstop active routing.

```

user@host>show vrrp nsr
Interface  State  Group  VR state  VR Mode  Type  NSR  RPD-NSR  Address
ge-1/0/1.0 up    1      master   Active   lcl  yes   yes     10.0.0.1
                                     vip                                10.0.0.3
ge-1/0/1.0 up    2      master   Active   lcl  yes   yes     20.0.0.1
                                     vip                                20.0.0.3
ge-1/0/1.0 up    3      master   Active   lcl  yes   yes     30.0.0.1
                                     vip                                30.0.0.3
ge-1/0/1.0 up    4      master   Active   lcl  yes   yes     40.0.0.1
                                     vip                                40.0.0.3
ge-1/0/1.0 up    5      master   Active   lcl  yes   yes     50.0.0.1

```



```

                                vip          50.0.0.3
ge-1/0/1.0 up 1 master Active lcl yes yes 1000::1
                                vip
fe80::200:5eff:fe00:1
                                vip          1000::3
ge-1/0/1.0 up 2 master Active lcl yes yes 2000::1
                                vip
fe80::200:5eff:fe00:2
                                vip          2000::3
ge-1/0/1.0 up 3 master Active lcl yes yes 3000::1
                                vip
fe80::200:5eff:fe00:3
                                vip          3000::3
ge-1/0/1.0 up 4 master Active lcl yes yes 4000::1
                                vip
fe80::200:5eff:fe00:4
                                vip          4000::3
ge-1/0/1.0 up 5 master Active lcl yes yes 5000::1
                                vip
fe80::200:5eff:fe00:5
                                vip          5000::3

```

### show vrrp summary

```

user@host> show vrrp summary
Interface   State      Group  VR state  Type  Address
ge-4/2/0.0 up         1      backup   lcl   10.57.0.2
                                vip   10.57.0.100

```

### show vrrp track detail

```

user@host> show vrrp track detail
Tracked interface: ae1.211
State: up, Speed: 400m
Incurred priority cost: 0
Threshold  Priority cost  Active
400m       10
300m       60
200m       110
100m       160
down       190
Tracking VRRP interface: ae0.210, Group: 1
VR State: master
Current priority: 200, Configured priority: 200
Priority hold-time: disabled, Remaining-time: 50.351

```

### show vrrp track summary

```

user@host> show vrrp track summary
Track if    State  Speed  VRRP if  Group  VR State  Current priority
ae1.211     up     400m   ae0.210  1      master    200

```



## traceroute ethernet

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Syntax</b>                   | <pre> traceroute ethernet local-mep <i>mep-id</i> maintenance-association <i>ma-name</i> maintenance-domain <i>md-name</i> &lt;ttl <i>value</i>&gt; &lt;wait <i>seconds</i>&gt; <i>mac-address</i>   <i>mep-id</i> &lt;detail&gt; </pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Release Information</b>      | <p>Command introduced in Junos OS Release 9.0.</p> <p><b>mep-id</b> option introduced in Junos OS Release 9.1.</p> <p><b>local-mep</b> option introduced in Junos OS Release 15.1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Description</b>              | <p>Triggers the linktrace protocol to trace the route between two maintenance points. The result of the traceroute protocol is stored in the path database. To display the path database, use the <b>show oam ethernet connectivity-fault-management path-database</b> command.</p> <p>Before using the traceroute command, you can verify the remote MEP's MAC address using the <b>show oam ethernet connectivity-fault-management path-database</b> command.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Options</b>                  | <p><b>local-mep <i>mep-id</i></b>—(Required when multiple MEPs are configured) Identifier for the local maintenance endpoint.</p> <p><b>detail</b>—(Optional) Provide detailed information of the responder hostname, ingress port name, egress port name, TTL, and relay action.</p> <p><b>mac-address</b>—Destination unicast MAC address of the remote maintenance point.</p> <p><b>mep-id</b>—MEP identifier of the remote maintenance point. The range of values is 1 through 8191.</p> <p><b>maintenance-association <i>ma-name</i></b>—Specifies an existing maintenance association from the set of configured maintenance associations.</p> <p><b>maintenance-domain <i>md-name</i></b>—Specifies an existing maintenance domain from the set of configured maintenance domains.</p> <p><b>ttl <i>value</i></b>—Number of hops to use in the linktrace request. The range is 1 to 255 hops. The default is 4.</p> <p><b>wait <i>seconds</i></b>—(Optional) Maximum time to wait for a response to the traceroute request. The range is 1 to 255 seconds. The default is 5.</p> |
| <b>Required Privilege Level</b> | network                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>List of Sample Output</b>    | <p><a href="#">traceroute ethernet on page 1865</a></p> <p><a href="#">traceroute ethernet detail on page 1865</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**Output Fields** Table 160 on page 1864 lists the output fields for the **traceroute ethernet** command. Output fields are listed in the approximate order in which they appear.

**Table 160: traceroute ethernet Output Fields**

| Field Name                     | Field Description                                                                                                                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Linktrace to</b>            | MAC address of the destination maintenance point.                                                                                                                                                                                                                            |
| <b>Interface</b>               | Local interface used to send the linktrace message (LTM).                                                                                                                                                                                                                    |
| <b>Maintenance Domain</b>      | Maintenance domain specified in the traceroute command.                                                                                                                                                                                                                      |
| <b>Level</b>                   | Maintenance domain level configured.                                                                                                                                                                                                                                         |
| <b>Maintenance Association</b> | Maintenance association specified in the traceroute command.                                                                                                                                                                                                                 |
| <b>Local Mep</b>               | The local maintenance end point identifier.                                                                                                                                                                                                                                  |
| <b>Transaction Identifier</b>  | 4-byte identifier maintained by the MEP. Each LTM uses a transaction identifier. The transaction identifier is maintained globally across all Maintenance Domains. Use the transaction identifier to match an incoming linktrace response (LTR), with a previously sent LTM. |
| <b>Hop</b>                     | Sequential hop count of the linktrace path.                                                                                                                                                                                                                                  |
| <b>TTL</b>                     | Number of hops remaining in the linktrace message. The time to live (TTL) is decremented at each hop.                                                                                                                                                                        |
| <b>Source MAC address</b>      | MAC address of the 802.1ag node responding to the LTM or the source MAC address of the LTR.                                                                                                                                                                                  |
| <b>Next-hop MAC address</b>    | MAC address of the egress interface of the node to which the LTM is forwarded or<br><br>the next-hop MAC address derived from the next egress identifier in the Egress-ID TLV of the LTR PDU.                                                                                |
| <b>Responder Hostname</b>      | The hostname of the responding router. A valid hostname is received only when the responding system is a Juniper Networks router.                                                                                                                                            |
| <b>Ingress port name</b>       | The port name for ingress connections.                                                                                                                                                                                                                                       |
| <b>Egress port name</b>        | The port name for egress connections.                                                                                                                                                                                                                                        |
| <b>Flags</b>                   | The configurable flags can include: <ul style="list-style-type: none"> <li>• H— Hardware only, incoming LT frame has hardware bit set.</li> <li>• T— Terminal MEP, responder is a terminating MEP.</li> <li>• F— FWD yes, LTM frame is relayed further.</li> </ul>           |

Table 160: traceroute ethernet Output Fields (*continued*)

| Field Name          | Field Description                                                                                                                                                                                                                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Relay Action</b> | The associated relay action. Relay action can be one of the following: <ul style="list-style-type: none"> <li>RlyHit— Relay hit; target MAC address matches the MP mac address.</li> <li>RlyFDB— Relay FDB; output port decided by consulting forwarding database.</li> <li>RlyMPDB— Relay MIP; output port decided by consulting MIP database.</li> </ul> |

## Sample Output

### traceroute ethernet

```
user@host> traceroute ethernet maintenance-domain md1 maintenance-association ma1
00:01:02:03:04:05
```

```
Linktrace to 00:01:02:03:04:05, Interface : ge-5/0/0.0
```

```
Maintenance Domain: MD1, Level: 7
```

```
Maintenance Association: MA1, Local Mep: 1
```

| Hop                           | TTL | Source MAC address | Next hop MAC address |
|-------------------------------|-----|--------------------|----------------------|
| Transaction Identifier:100001 |     |                    |                      |
| 1                             | 63  | 00:00:aa:aa:aa:aa  | 00:00:ab:ab:ab:ab    |
| 2                             | 62  | 00:00:bb:bb:bb:bb  | 00:00:bc:bc:bc:bc    |
| 3                             | 61  | 00:00:cc:cc:cc:cc  | 00:00:cd:cd:cd:cd    |
| 4                             | 60  | 00:01:02:03:04:05  | 00:00:00:00:00:00    |

### traceroute ethernet detail

```
user@host> run traceroute ethernet maintenance-domain md6 maintenance-association ma6
mep 101 detail
```

```
Linktrace to 00:00:5E:00:53:CC, Interface : ge-1/0/0.1
```

```
Maintenance Domain: md6, Level: 6
```

```
Maintenance Association: ma6, Local Mep: 201
```

```
Transaction Identifier: 2077547465
```

#### Legend for RelayAction:

```
RlyHit -- Relay hit, Target MAC address matches the MP mac address
```

```
RlyFDB -- Relay FDB, output port decided by consulting FDB database
```

```
RlyMPDB -- Relay MIP, output port decided by consulting MIP database
```

#### Legend for Flags:

```
H -- Hardware only, incoming LT frame has hardware bit set
```

```
T -- Terminal MEP, responder is a terminating MEP
```

```
F -- FWD yes, LTM frame is relayed further
```

| TTL               | Responder Hostname | Ingress port name | Egress port name  | RelayAction |
|-------------------|--------------------|-------------------|-------------------|-------------|
| Responder Service |                    |                   |                   |             |
| 62                | host1              | ge-1/0/0.1        | ge-2/3/0.1        | RlyFDB      |
| br1               |                    | 00:00:5E:00:53:00 | 00:00:5E:00:53:A0 | HF-         |
| 63                | host2              | ge-2/3/0.1        | ge-1/0/0.1        | RlyFDB      |
| br1               |                    | 00:00:5E:00:53:AA | 00:00:5E:00:53:A2 | HF-         |
| 61                | host3              | ge-1/0/0.1        | --:--             | RlyHit      |
| br1               |                    | 00:00:5E:00:53:B0 | --:--             | H-T         |



## PART 6

# Index

- [Index on page 1869](#)





# Index

## Symbols

|                                               |                 |
|-----------------------------------------------|-----------------|
| #, comments in configuration statements.....  | xlvi            |
| ( ), in syntax descriptions.....              | xlvi            |
| 10-Gigabit Ethernet interfaces.....           | 4               |
| 802.3ah OAM.....                              | 612             |
| DWDM                                          |                 |
| data and alarms, displaying.....              | 1528            |
| status information, displaying.....           | 1654, 1657      |
| 10-Gigabit Ethernet LAN/WAN PIC               |                 |
| control queue disable.....                    | 366             |
| handling oversubscription.....                | 369             |
| line rate mode.....                           | 365             |
| no-pre-classifier statement.....              | 1084            |
| oversubscribed Ethernet mode                  |                 |
| control queue disable.....                    | 366, 1084       |
| oversubscribed mode.....                      | 365             |
| 100-Gigabit Ethernet                          |                 |
| configuration                                 |                 |
| forwarding-mode.....                          | 974, 975        |
| interoperability modes.....                   | 406             |
| sa-multicast.....                             | 406, 1162, 1163 |
| vlan-rule.....                                | 1244            |
| vlan-steering.....                            | 406, 1245       |
| forwarding-mode                               |                 |
| sa-multicast.....                             | 1163            |
| forwarding-options                            |                 |
| sa-multicast.....                             | 1162            |
| vlan-steering.....                            | 1245            |
| vlan-steering                                 |                 |
| vlan-rule.....                                | 1244            |
| 100-Gigabit Ethernet interfaces.....          | 1528            |
| Overview.....                                 | 395             |
| 100-Gigabit Ethernet PIC                      |                 |
| configuration.....                            | 402             |
| Overview.....                                 | 399             |
| 100-Gigabit Ethernet PIC on Type 5 FPC        |                 |
| configuration                                 |                 |
| interoperability modes.....                   | 413, 415        |
| sa-multicast.....                             | 413, 415        |
| Overview.....                                 | 408             |
| 40-Gigabit Ethernet interfaces.....           | 1528            |
| 40-Gigabit Ethernet PIC                       |                 |
| configuration.....                            | 393             |
| Overview.....                                 | 391             |
| 802.1Q VLANs                                  |                 |
| mixed VLAN tagging.....                       | 970, 1077       |
| VLAN IDs.....                                 | 1237, 1242      |
| values, listed by Ethernet interface          |                 |
| type.....                                     | 237             |
| VLAN tagging.....                             | 1246            |
| 802.1x Port-Based Network Access Control..... | 931             |
| 802.1X, static MAC list.....                  | 1006            |
| 802.3ad statement.....                        | 854             |
| usage guidelines.....                         | 126             |
| 802.3ah OAM                                   |                 |
| example configuration.....                    | 612             |
| < >, in syntax descriptions.....              | xlvi            |
| [ ], in configuration statements.....         | xlvi            |
| { }, in configuration statements.....         | xlvi            |
| (pipe), in syntax descriptions.....           | xlvi            |
| <b>A</b>                                      |                 |
| accept-source-mac statement.....              | 855             |
| usage guidelines.....                         | 468             |
| access-concentrator statement.....            | 856             |
| usage guidelines.....                         | 331             |
| account-layer2-overhead (PIC level)           |                 |
| statement.....                                | 857             |
| accounting of Layer 2 overhead                |                 |
| viewing.....                                  | 462             |
| ACI (agent circuit identifier) interface sets |                 |
| status information, displaying.....           | 1654            |
| action statement                              |                 |
| OAM.....                                      | 857             |
| action-profile statement.....                 | 861             |
| applying to remote MEP.....                   | 858             |
| CFM.....                                      | 859             |
| LFM.....                                      | 860             |
| adaptive.....                                 | 862, 1035       |
| adaptive services interfaces.....             | 1500            |
| status information, displaying.....           | 1500            |
| Address Resolution Protocol See ARP           |                 |
| address statement.....                        | 863             |
| adjacency-loss statement.....                 | 866             |
| ADSL                                          |                 |
| example configuration.....                    | 337             |
| advertisement-interval statement.....         | 867             |
| age statement.....                            | 868             |
| agent-specifier statement                     |                 |
| PPPoE.....                                    | 869             |

|                                                                                                                                              |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| aggregate statement                                                                                                                          |                     |
| usage guidelines.....                                                                                                                        | 465, 466            |
| aggregated devices, configuring.....                                                                                                         | 140                 |
| aggregated Ethernet                                                                                                                          |                     |
| clearing load balance states in a periodic manner.....                                                                                       | 1150                |
| defining stateful load-balancing configuration.....                                                                                          | 1036                |
| enabling stateful load-balancing for traffic flows .....                                                                                     | 1037, 1109          |
| aggregated Ethernet interfaces.....                                                                                                          | 126                 |
| example configuration.....                                                                                                                   | 139                 |
| link speed.....                                                                                                                              | 144                 |
| minimum links.....                                                                                                                           | 145                 |
| multicast statistics.....                                                                                                                    | 201                 |
| status information, displaying.....                                                                                                          | 1508                |
| VLAN IDs.....                                                                                                                                | 237                 |
| aggregated Ethernet interfaces with link protection                                                                                          |                     |
| manually switching to the backup link.....                                                                                                   | 1298                |
| reverting to the primary link.....                                                                                                           | 1298                |
| aggregated Ethernet LACP link protection                                                                                                     |                     |
| manually switching.....                                                                                                                      | 1299                |
| aggregated Ethernet on PTX Series Packet Transport Routers                                                                                   |                     |
| configuring.....                                                                                                                             | 128                 |
| aggregated-devices statement.....                                                                                                            | 871                 |
| usage guidelines.....                                                                                                                        | 140                 |
| aggregated-ether-options statement.....                                                                                                      | 872                 |
| aging timer                                                                                                                                  |                     |
| ARP.....                                                                                                                                     | 19                  |
| ais-trigger-condition statement.....                                                                                                         | 873                 |
| alarm statement.....                                                                                                                         | 874                 |
| alarms                                                                                                                                       |                     |
| Fast Ethernet interfaces, checklist.....                                                                                                     | 801                 |
| Gigabit Ethernet interfaces, checklist.....                                                                                                  | 801                 |
| LINK, displaying.....                                                                                                                        | 801                 |
| alarms statement.....                                                                                                                        | 874                 |
| all (tracing flag)                                                                                                                           |                     |
| VRRP.....                                                                                                                                    | 19                  |
| all-defects statement.....                                                                                                                   | 875, 918, 947, 1150 |
| allow-remote-loopback statement.....                                                                                                         | 875                 |
| apply-action-profile statement.....                                                                                                          | 876                 |
| APS (automatic protection switching)                                                                                                         |                     |
| unidirectional switching, bidirectional switching, selective selectors, merging selectors, revertive switching, non-revertive switching..... | 205                 |
| ARP                                                                                                                                          |                     |
| aging timer.....                                                                                                                             | 19                  |
| arp statement.....                                                                                                                           | 877                 |
| asynchronous-notification statement.....                                                                                                     | 878                 |
| authentication-profile-name statement.....                                                                                                   | 880                 |
| authenticator statement.....                                                                                                                 | 879, 881            |
| auto-discovery statement.....                                                                                                                | 882                 |
| auto-negotiation statement                                                                                                                   |                     |
| Gigabit Ethernet.....                                                                                                                        | 883                 |
| auto-reconnect statement.....                                                                                                                | 884                 |
| usage guidelines.....                                                                                                                        | 331                 |
| autonegotiation, table.....                                                                                                                  | 783                 |
| <b>B</b>                                                                                                                                     |                     |
| backward-frr-enable statement.....                                                                                                           | 889                 |
| bandwidth-limit statement                                                                                                                    |                     |
| policer for Gigabit Ethernet interface.....                                                                                                  | 890                 |
| usage guidelines.....                                                                                                                        | 466                 |
| bcm0 interface.....                                                                                                                          | 21                  |
| ber-threshold-signal-degrade statement.....                                                                                                  | 896                 |
| BERT                                                                                                                                         |                     |
| configuring interface diagnostics.....                                                                                                       | 773                 |
| bert-algorithm statement                                                                                                                     |                     |
| usage guidelines.....                                                                                                                        | 773                 |
| bert-error-rate statement                                                                                                                    |                     |
| usage guidelines.....                                                                                                                        | 773                 |
| bert-period statement                                                                                                                        |                     |
| usage guidelines.....                                                                                                                        | 773                 |
| bfd-liveness-detection statement                                                                                                             |                     |
| BFD                                                                                                                                          |                     |
| LAG.....                                                                                                                                     | 899                 |
| bit error rate test See BERT                                                                                                                 |                     |
| braces, in configuration statements.....                                                                                                     | xlvi                |
| brackets                                                                                                                                     |                     |
| angle, in syntax descriptions.....                                                                                                           | xlvi                |
| square, in configuration statements.....                                                                                                     | xlvi                |
| bridge network                                                                                                                               |                     |
| trunk interface.....                                                                                                                         | 253                 |
| bridge-domain statement.....                                                                                                                 | 891                 |
| bridge-domains statement.....                                                                                                                | 892                 |
| burst-size-limit statement                                                                                                                   |                     |
| policer for Gigabit Ethernet interface.....                                                                                                  | 901                 |
| usage guidelines.....                                                                                                                        | 466                 |
| bypass statement.....                                                                                                                        | 901, 1068           |
| bytes statement.....                                                                                                                         | 902                 |
| <b>C</b>                                                                                                                                     |                     |
| cables                                                                                                                                       |                     |
| damaged or dirty.....                                                                                                                        | 792                 |
| mismatch.....                                                                                                                                | 792                 |

- multimode fiber.....785
- single-mode fiber.....785
- calculation-weight statement.....903
- captive-portal statement (Unified Access Control policy).....904
- CCC
  - encapsulation
    - VLAN-bundled dual-tag logical interfaces.....1248
    - VLAN-bundled single-tag logical interfaces.....1239
- CCM
  - Configuring CCM for Better Scalability.....572
  - Configuring Faster Convergence.....575
  - Configuring Faster Protection Switching.....573
  - Configuring Primary VLAN ID.....576
  - Remote Maintenance Association.....577
- centralized ppm statement.....907
- CFM statistics
  - clearing.....1275
  - displaying for CFM interfaces.....1742
  - displaying for interfaces.....1724
- chassis
  - installed hardware, displaying.....1300
  - serial numbers, displaying.....1300
- chassis statement.....908
- checklist for alarms
  - Fast Ethernet interfaces .....801
  - Gigabit Ethernet interfaces .....801
- checklist for monitoring
  - Fast Ethernet interfaces.....777
  - Gigabit Ethernet interfaces.....777
- circuit cross-connect (CCC)
  - encapsulation
    - VLAN-bundled dual-tag logical interfaces.....1248
    - VLAN-bundled single-tag logical interfaces.....1239
- circuit problems
  - Fast Ethernet interfaces .....800
  - Gigabit Ethernet interfaces .....800
- classifier statement.....909
  - usage guidelines.....467
- clear interfaces aggregate forwarding-options
  - load-balance statecommand.....1266, 1267
- clear interfaces interface-set statistics
  - command.....1262
- clear interfaces interval command.....1263
- clear interfaces statistics command
  - Fast Ethernet interfaces.....785
  - Fast Ethernet statistics.....797
- clear interfaces transport pm statement.....1268
- clear lldp neighbor command.....1269
- clear lldp statistics command.....1270
- clear oam ethernet connectivity-fault-management
  - continuity-measurement command.....1271
- clear oam ethernet connectivity-fault-management
  - linktrace path-database command.....1272
- clear oam ethernet connectivity-fault-management
  - loss-statistics command.....1273
- clear oam ethernet connectivity-fault-management
  - policer command.....1274
- clear oam ethernet connectivity-fault-management
  - statistics.....1275
- clear oam ethernet connectivity-fault-management
  - synthetic-loss-measurement command.....1276
- clear oam ethernet link-fault-management state
  - command.....1277
- clear oam ethernet link-fault-management
  - statistics command.....1278
- clear protection-group ethernet-ring statistics
  - command.....1279
- clear statement.....909
- client statement.....910
- comments, in configuration statements.....xlvi
- community-vlan statement.....910, 1013
- compatibility-version statement.....911
- configuration
  - aggregated devices.....140
- configuring
  - LLDP.....316
- Configuring a Layer 2 Circuit on a VLAN-Bundled
  - Logical Interface.....257
- Configuring a VLAN-Bundled Logical
  - Interface.....248, 256, 257
- Configuring CCM for Better Scalability.....572
- Configuring Faster Convergence.....575
- Configuring Faster Protection Switching.....573
- Configuring FNP.....692
- Configuring Logical Link-Layer Encapsulation to
  - Support CCCs.....260
- Configuring Primary VLAN ID.....576
- Configuring Remote Maintenance Association.....577
- Configuring Unified ISSU for 801.1ag CFM .....569
- Configuring VLAN ID List-Bundled Logical Interfaces
  - That Connect CCCs.....260

|                                                 |           |
|-------------------------------------------------|-----------|
| connections                                     |           |
| configuration statements.....                   | 845, 850  |
| connectivity-fault management.....              | 858, 859  |
| connectivity-fault-management                   |           |
| linktrace database, clearing.....               | 1272      |
| connectivity-fault-management statement.....    | 914       |
| continuity measurement                          |           |
| displaying statistics and frame counts.....     | 691       |
| continuity-check statement.....                 | 916       |
| control-channel statement.....                  | 917       |
| conventions                                     |           |
| text and syntax.....                            | xlvi      |
| convey-loss-threshold statement.....            | 917       |
| counters.....                                   | 797       |
| CSU alarm                                       |           |
| clearing.....                                   | 1263      |
| cumulative statistics                           |           |
| Ethernet interfaces.....                        | 785       |
| curly braces, in configuration statements.....  | xlvi      |
| customer support.....                           | xlvi      |
| contacting JTAC.....                            | xlvi      |
| cycle-time statement.....                       | 918       |
| <b>D</b>                                        |           |
| data-channel statement.....                     | 919       |
| data-tlv-size statement.....                    | 920       |
| database (tracing flag).....                    | 19        |
| default-actions statement.....                  | 921       |
| delay statement.....                            | 922       |
| PPPoE service name tables.....                  | 923       |
| delay-variation statement.....                  | 924       |
| delegate-server-processing statement.....       | 924       |
| detect statement.....                           | 925       |
| detection-time statement                        |           |
| BFD                                             |           |
| LAG.....                                        | 899       |
| device-count statement.....                     | 926       |
| usage guidelines.....                           | 140       |
| direction statement.....                        | 928       |
| disable statement                               |           |
| 802.1X connections.....                         | 930       |
| link protection.....                            | 929       |
| LLDP.....                                       | 929       |
| documentation                                   |           |
| comments on.....                                | xlvi      |
| domain-id statement.....                        | 933       |
| dot1p-priority statement.....                   | 930       |
| dot1x                                           |           |
| configuration statements.....                   | 846       |
| dot1x statement.....                            | 931       |
| authenticator.....                              | 931       |
| authentication-profile-name.....                | 931       |
| interface.....                                  | 931       |
| <i>See also</i> maximum-requests                |           |
| <i>See also</i> quiet-period                    |           |
| <i>See also</i> reauthentication                |           |
| <i>See also</i> retries                         |           |
| <i>See also</i> server-timeout                  |           |
| <i>See also</i> supplicant                      |           |
| <i>See also</i> supplicant-timeout              |           |
| <i>See also</i> transmit-period                 |           |
| for MX Series routers in enhanced LAN           |           |
| mode.....                                       | 932       |
| drop statement                                  |           |
| PPPoE service name tables.....                  | 933       |
| dual-tag framing                                |           |
| VLAN ID list.....                               | 1248      |
| DWDM 10-Gigabit Ethernet interfaces             |           |
| data and alarms, displaying.....                | 1528      |
| dynamic PPPoE statements                        |           |
| max-sessions-vsa-ignore.....                    | 1057      |
| pp0.....                                        | 1126      |
| pppoe-underlying-options.....                   | 1129      |
| dynamic profiles statements                     |           |
| vlan-tags.....                                  | 1247      |
| dynamic subscribers                             |           |
| max-sessions-vsa-ignore statement.....          | 1057      |
| pppoe-underlying-options statement.....         | 1129      |
| dynamic-profile statement                       |           |
| PPPoE service name tables.....                  | 934       |
| <b>E</b>                                        |           |
| E-LMI.....                                      | 540, 1034 |
| east-interface statement.....                   | 935       |
| edit interfaces fastether-options command ..... | 789       |
| edit interfaces gigether-options command.....   | 789       |
| egress-policer-overhead statement.....          | 936       |
| em1 interface.....                              | 21        |
| encapsulation                                   |           |
| extended VLAN CCC.....                          | 351       |
| encapsulation statement                         |           |
| logical interfaces.....                         | 937       |
| physical interface.....                         | 941       |
| error statistics                                |           |
| Fast Ethernet interfaces .....                  | 798       |
| Gigabit Ethernet interfaces.....                | 798       |

- errors
  - Ethernet interfaces.....785
  - Fast Ethernet interfaces, table .....782
  - Gigabit Ethernet interfaces, table .....782
- ETH-DM See monitor ethernet delay-measurement command
  - configuring routers to support.....664, 671
  - displaying statistics and frame counts.....667, 679
  - overview.....622
  - starting an ETH-DM session.....665, 675
- ETH-DM frame counts (with CFM statistics)
  - displaying for MEPs by enclosing CFM.....1742
  - displaying for MEPs by interface or domain level.....1724
- ETH-DM statistics (only)
  - displaying.....1716
- ETH-DM statistics and frame counts
  - clearing.....1275
  - displaying.....1753
- ETH-LM See monitor ethernet loss-measurement command
  - displaying statistics and frame counts.....690
  - for dual tagged LMM/LMR PDUs
    - example.....722
  - for single tagged LMM/LMR PDUs
    - example.....711
  - overview.....628
- ETH-LM for dual tagged LMM/LMR PDUs
  - example.....722
- ETH-LM for single tagged LMM/LMR PDUs
  - example.....711
- ETH-LM statistics (only)
  - displaying.....1738
- ETH-LM statistics and frame counts
  - clearing.....1273
- ETH-SLM See monitor ethernet synthetic-loss-measurement command
  - configuration scenarios.....635
  - displaying statistics and frame counts.....647
  - format of PDUs or messages.....637
  - guidelines to configure.....641
  - overview.....634
  - steps to troubleshoot failures.....651
  - transmission of PDUs or messages.....639
- ETH-SLM frame counts (with CFM statistics)
  - displaying for MEPs by enclosing CFM.....1742
  - displaying for MEPs by interface or domain level.....1724
- ETH-SLM statistics (only)
  - displaying.....1774
- ether-options statement.....948
- Ethernet
  - CFM.....577, 580, 583
  - LFM example.....613, 615, 616, 618
  - OAM overview.....518
  - ring protection example.....740
  - ring protection failure condition.....765
  - ring protection normal operation.....763
  - ring protection overview.....737, 739
- Ethernet 802.3ah OAM on PTX Series Packet Transport Routers
  - configuring.....596
- Ethernet continuity measurement
  - displaying statistics and frame counts.....691
- Ethernet failure notification protocol
  - configuring.....692
  - overview.....633
- Ethernet frame
  - delay measurement (ETH-DM),
    - displaying.....1282
  - loss-measurement (ETH-LM),
    - displaying.....1287
  - synthetic loss measurement (ETH-SLM),
    - displaying.....1292
- Ethernet frame delay
  - examples.....700, 705, 709
  - statistics.....734, 735
- Ethernet frame delay measurement
  - configuring routers to support.....664, 671
  - displaying statistics and frame counts.....667, 679
  - overview.....622
  - starting an ETH-DM session.....665, 675
- Ethernet frame loss measurement
  - displaying statistics and frame counts.....690
  - for dual tagged LMM/LMR PDUs.....722
  - for single tagged LMM/LMR PDUs.....711
  - overview.....628
- Ethernet interface set
  - status information, displaying.....1654
- Ethernet interface set queue
  - status information, displaying.....1657

|                                               |                    |
|-----------------------------------------------|--------------------|
| Ethernet interfaces                           |                    |
| autonegotiation, table.....                   | 783                |
| CFM statistics                                |                    |
| clearing.....                                 | 1275               |
| displaying for CFM interfaces.....            | 1742               |
| displaying for interfaces.....                | 1724               |
| connectivity-fault-management.....            | 1272               |
| ETH-DM frame counts (with CFM statistics)     |                    |
| displaying for MEPs by enclosing              |                    |
| CFM.....                                      | 1742               |
| displaying for MEPs by interface or domain    |                    |
| level.....                                    | 1724               |
| ETH-DM statistics (only)                      |                    |
| displaying.....                               | 1716               |
| ETH-DM statistics and frame counts            |                    |
| clearing.....                                 | 1275               |
| displaying.....                               | 1753               |
| ETH-LM statistics (only)                      |                    |
| displaying.....                               | 1738               |
| ETH-LM statistics and frame counts            |                    |
| clearing.....                                 | 1273               |
| ETH-SLM frame counts (with CFM statistics)    |                    |
| displaying for MEPs by enclosing              |                    |
| CFM.....                                      | 1742               |
| displaying for MEPs by interface or domain    |                    |
| level.....                                    | 1724               |
| ETH-SLM statistics (only)                     |                    |
| displaying.....                               | 1774               |
| example configuration.....                    | 5                  |
| gratuitous ARP.....                           | 18                 |
| mixed VLAN tagging.....                       | 970, 1077          |
| multicast statistics.....                     | 20                 |
| OAM state, clearing.....                      | 1277               |
| OAM statistics, clearing.....                 | 1278               |
| protection group statistics, clearing.....    | 1279               |
| RJ-45 .....                                   | 788                |
| specifications, table.....                    | 785                |
| status information, displaying                |                    |
| aggregated.....                               | 1508               |
| Fast Ethernet.....                            | 1563               |
| Gigabit Ethernet.....                         | 1579, 1603         |
| internal.....                                 | 1628               |
| management.....                               | 1628               |
| VLAN IDs.....                                 | 1237               |
| VLAN tagging.....                             | 1246               |
| Ethernet link aggregation.....                | 126                |
| Ethernet Local Management Interface See E-LMI |                    |
| ethernet ring                                 |                    |
| protection group APS.....                     | 1812               |
| protection group data channel.....            | 1822, 1837         |
| protection group flush-info.....              | 1824               |
| protection group interface.....               | 1826               |
| protection group node state.....              | 1829               |
| protection group statistics.....              | 1833               |
| Ethernet Ring Protection                      |                    |
| configuration statements.....                 | 851                |
| ethernet statement.....                       | 949, 950           |
| chassis.....                                  | 949                |
| usage guidelines.....                         | 140                |
| Ethernet synthetic loss measurement           |                    |
| debugging procedure for failures.....         | 651                |
| displaying statistics and frame counts.....   | 647                |
| format of PDUs or messages.....               | 637                |
| guidelines to configure.....                  | 641                |
| overview.....                                 | 634                |
| scenarios for deployment.....                 | 635                |
| transmission of PDUs or messages.....         | 639                |
| Ethernet VLAN circuit                         |                    |
| VLAN ID list.....                             | 1239               |
| ethernet-policer-profile statement.....       | 953                |
| usage guidelines.....                         | 465, 466           |
| ethernet-ring statement.....                  | 954                |
| ethernet-switch-profile statement.....        | 470, 955           |
| usage guidelines.....                         | 465, 487           |
| evcs statement.....                           | 957                |
| event statement.....                          | 959                |
| convey-loss-threshold statement.....          | 917                |
| interface-status-tlv statement.....           | 1009               |
| port-status-tlv statement.....                | 1125               |
| event-thresholds                              |                    |
| frame-error statement.....                    | 976                |
| frame-period statement.....                   | 977                |
| frame-period-summary statement.....           | 978                |
| symbol-period statement.....                  | 1196               |
| event-thresholds statement.....               | 959                |
| example                                       |                    |
| LLDP.....                                     | 319                |
| examples                                      |                    |
| Ethernet frame delay.....                     | 700, 705, 709      |
| Ethernet LFM.....                             | 613, 615, 616, 618 |
| Ethernet ring failure condition.....          | 765                |
| Ethernet ring normal operation.....           | 763                |
| Ethernet ring protection.....                 | 740                |
| extended VLAN                                 |                    |
| TCC                                           |                    |
| applying.....                                 | 351                |

**F**

|                                                                  |               |
|------------------------------------------------------------------|---------------|
| failover-delay statement.....                                    | 961           |
| usage guidelines.....                                            | 324           |
| failure notification, Ethernet See Ethernet failure notification |               |
| family bridge                                                    |               |
| VLAN ID list.....                                                | 1241          |
| family statement.....                                            | 962           |
| Fast Ethernet interfaces                                         |               |
| alarms, LINK.....                                                | 801           |
| autonegotiation, table.....                                      | 783           |
| circuit problems.....                                            | 785, 800      |
| clear interfaces statistics command.....                         | 797           |
| counters .....                                                   | 802           |
| Ethernet link aggregation.....                                   | 126           |
| example configuration.....                                       | 5             |
| ignoring Layer 3 incomplete errors.....                          | 18            |
| ingress rate-limit.....                                          | 9             |
| LINK alarms, checklist .....                                     | 801           |
| link modes.....                                                  | 12            |
| link protection.....                                             | 157           |
| local loopback, configuring .....                                | 789           |
| loopback mode.....                                               | 17            |
| monitor checklist.....                                           | 777           |
| monitor interface command .....                                  | 784           |
| monitoring.....                                                  | 784           |
| physical loopback.....                                           | 788           |
| ping interface command.....                                      | 797           |
| set cli terminal command .....                                   | 785           |
| set loopback local command .....                                 | 789           |
| show interfaces command .....                                    | 780, 790, 798 |
| show interfaces extensive command.....                           | 781, 801      |
| show interfaces terse command .....                              | 778           |
| speed.....                                                       | 8             |
| statistics                                                       |               |
| checking error .....                                             | 798           |
| monitoring.....                                                  | 798           |
| resetting.....                                                   | 797           |
| status                                                           |               |
| description, table.....                                          | 778           |
| displaying.....                                                  | 778           |
| errors, table.....                                               | 782           |
| verifying.....                                                   | 790           |
| status information, displaying.....                              | 1563          |
| VLAN IDs.....                                                    | 237, 1237     |
| VLAN tagging.....                                                | 1246          |
| fast-aps-switch statement.....                                   | 966           |
| fastether-options statement.....                                 | 967           |
| fec statement.....                                               | 968           |

|                                                            |          |
|------------------------------------------------------------|----------|
| fiber-optic                                                |          |
| connection.....                                            | 785      |
| Ethernet interface specifications, table.....              | 785      |
| interface, physical loopback.....                          | 788      |
| fixed-stuff-bytes statement.....                           | 969      |
| flexible-vlan-tagging statement.....                       | 970      |
| flow control.....                                          | 11       |
| flow-control statement.....                                | 971      |
| usage guidelines.....                                      | 11       |
| FNP.....                                                   | 972      |
| configuration.....                                         | 692      |
| overview.....                                              | 633      |
| fnp statement                                              |          |
| Ethernet OAM.....                                          | 972      |
| show oam ethernet fnp interface.....                       | 1778     |
| show oam ethernet fnp messages.....                        | 1779     |
| show oam ethernet fnp status .....                         | 1781     |
| font conventions.....                                      | xlv      |
| force switch statement.....                                | 972      |
| force-up statement.....                                    | 973      |
| forwarding-class statement                                 |          |
| usage guidelines.....                                      | 467      |
| forwarding-mode statement.....                             | 974, 975 |
| FPC                                                        |          |
| installed, displaying list.....                            | 1301     |
| frame delay, Ethernet See Ethernet frame delay measurement |          |
| frame loss, Ethernet See Ethernet frame loss measurement   |          |
| frame-error statement.....                                 | 976      |
| frame-period statement.....                                | 977      |
| frame-period-summary statement.....                        | 978      |
| framing statement                                          |          |
| 10-Gigabit Ethernet interfaces.....                        | 979      |

**G**

|                                          |      |
|------------------------------------------|------|
| general (tracing flag).....              | 19   |
| Gigabit Ethernet interfaces.....         | 4    |
| alarms, LINK.....                        | 801  |
| autonegotiation, table.....              | 783  |
| circuit problems.....                    | 800  |
| counters.....                            | 802  |
| demultiplexing interface information,    |      |
| displaying.....                          | 1519 |
| diagnostics information, displaying..... | 1528 |
| Ethernet link aggregation.....           | 126  |
| example configuration.....               | 6    |
| flow control.....                        | 11   |
| ignoring Layer 3 incomplete errors.....  | 18   |



|                                               |                        |
|-----------------------------------------------|------------------------|
| LACP, displaying.....                         | 1695                   |
| LINK alarms, checklist .....                  | 801                    |
| link protection.....                          | 157                    |
| local loopback, configuring.....              | 789                    |
| loopback mode.....                            | 17                     |
| loopback plug, creating.....                  | 788                    |
| MAC database, displaying.....                 | 1675                   |
| monitor checklist.....                        | 777                    |
| monitor interface command.....                | 784                    |
| monitoring.....                               | 784                    |
| physical loopback, creating .....             | 788                    |
| ping interface command.....                   | 797                    |
| set cli terminal command.....                 | 785                    |
| set loopback local command.....               | 789                    |
| show interfaces command.....                  | 780, 790               |
| show interfaces extensive command.....        | 781, 801               |
| show interfaces terse command.....            | 779                    |
| statistics                                    |                        |
| checking error.....                           | 798                    |
| monitoring.....                               | 798                    |
| resetting.....                                | 797                    |
| status                                        |                        |
| description, table.....                       | 779                    |
| displaying specific.....                      | 780                    |
| errors, table.....                            | 782                    |
| extensive.....                                | 781                    |
| verifying.....                                | 790                    |
| status information,                           |                        |
| displaying.....                               | 1579, 1603, 1654, 1657 |
| VLAN IDs.....                                 | 237, 1237, 1242        |
| VLAN tagging.....                             | 1246                   |
| Gigabit Ethernet IQ interfaces                |                        |
| MAC address accounting.....                   | 457                    |
| MAC address filtering.....                    | 469                    |
| policer                                       |                        |
| example configuration.....                    | 470                    |
| rate limiting.....                            | 465, 466               |
| Gigabit Ethernet IQ PIC                       |                        |
| traffic and MAC statistics.....               | 1603                   |
| Gigabit Ethernet uPIM interfaces              |                        |
| speed.....                                    | 8                      |
| gigether-options statement.....               | 980                    |
| gratuitous ARP.....                           | 18                     |
| gratuitous-arp-reply statement.....           | 981                    |
| usage guidelines.....                         | 18                     |
| guard-interval statement.....                 | 983                    |
| guest-vlan statement.....                     | 982                    |
| <b>H</b>                                      |                        |
| hardware, installed, displaying.....          | 1300                   |
| hardware-assisted-keepalives statement.....   | 985                    |
| hardware-assisted-timestamping statement..... | 984                    |
| hold-interval statement                       |                        |
| connectivity-fault management.....            | 986                    |
| Ethernet ring protection switching.....       | 986                    |
| hold-multiplier statement.....                | 987                    |
| holddown-interval statement                   |                        |
| BFD                                           |                        |
| LAG.....                                      | 899                    |
| <b>I</b>                                      |                        |
| iccp                                          |                        |
| configuration statements.....                 | 846                    |
| IEEE 802.1p inheritance                       |                        |
| and transparent tag.....                      | 509                    |
| swap-by-poppush statement.....                | 511                    |
| transparent statement.....                    | 511                    |
| transparent tag.....                          | 511                    |
| IEEE 802.1p policer profile                   |                        |
| usage guidelines.....                         | 466                    |
| ieee802.1p statement.....                     | 989                    |
| IGMP snooping                                 |                        |
| enabling.....                                 | 990                    |
| multicast-router interface.....               | 1074                   |
| igmp-snooping statement.....                  | 990                    |
| ignore-l3-incompletes statement.....          | 991                    |
| ignoring Layer 3 incomplete errors.....       | 18                     |
| ingress-policer-overhead statement.....       | 993                    |
| ingress-rate-limit statement.....             | 994                    |
| usage guidelines.....                         | 9                      |
| inner-tag-protocol-id statement.....          | 995                    |
| inner-vlan-id statement.....                  | 996                    |
| input-policer statement.....                  | 997                    |
| input-priority-map statement.....             | 998                    |
| usage guidelines.....                         | 466                    |
| input-three-color statement.....              | 999                    |
| instance statement.....                       | 1002                   |
| integrated routing and bridging interfaces    |                        |
| integrated routing and bridging interfaces,   |                        |
| displaying.....                               | 1669                   |
| interface statement.....                      | 1006                   |
| IEEE 802.1X.....                              | 1004                   |
| IEEE 802.3ah.....                             | 1005                   |
| LLDP.....                                     | 1003                   |
| usage guidelines.....                         | 253                    |
| interface-down statement.....                 | 921, 1006              |



- interface-mode statement
    - usage guidelines.....252
  - interface-status-tlv statement.....1009
  - interfaces
    - configuration statements.....822
    - Gigabit Ethernet IQ policer
      - example configuration.....470
    - mixed VLAN tagging.....970, 1077
  - interfaces (tracing flag).....19
  - interfaces statement.....1007
  - internal Ethernet interface
    - status information, displaying.....1628
  - interval statement.....1010, 1011
  - IP addresses
    - management Ethernet interface.....26
  - is-ma statement.....1012
  - iteration-count statement.....1014
  - iteration-period
    - statement.....885, 886, 887, 888, 1014
  - Iterator
    - verifying configuration.....654
  - Iterator profile
    - configuration.....644, 652
  - iterator statistics.....657
  - iterators
    - VPLS connections.....663
  - ITU-T standards
    - Y.1731.....633
    - Y.1731 ETH-DM.....622
    - Y.1731 ETH-LM.....628
  - ITU-Y.1731
    - VPLS connections.....663
  - ixgbe0 interface.....21
  - ixgbe1 interface.....21
- J**
- jitter, Ethernet frame See Ethernet frame delay measurement
- L**
- lACP
    - force-up.....973
  - LACP
    - displaying.....1695
  - lACP statement
    - 802.3ad.....1017
    - Aggregated Ethernet.....1018
  - laser-enable statement.....1019
  - Layer 2 bridging
    - learning properties, displaying.....1689, 1691
  - Layer 2.5 VPNs
    - Ethernet.....351
  - Layer 3 incomplete errors.....991
  - layer2-policer statement.....1020
  - learning properties
    - Layer 2, displaying.....1689, 1691
  - level statement.....1021
  - line-loopback statement.....1022
  - link aggregation.....126
  - link layer discovery protocol See LLDP
  - link modes.....12
  - link protection
    - aggregated Ethernet interfaces
      - configuring.....157
      - configuring primary and backup links.....157
      - disabling.....158
      - reverting traffic to primary link.....157
    - disable statement.....929
    - non-revertive statement.....1086
    - revertive statement.....1158
  - link speed
    - Ethernet aggregation.....144
  - link-adjacency-loss statement.....1023
  - link-discovery statement.....1023
  - link-down statement.....1024
  - link-event-rate statement.....1024
  - link-fault management.....860
  - link-fault-management statement.....1025
  - link-mode statement.....1027
    - usage guidelines.....12
  - link-protected aggregated Ethernet interfaces
    - manually switching to the backup link.....1298
    - reverting to the primary link.....1298
  - link-protected aggregated Ethernet LACP links
    - manually switching.....1299
  - link-protection statement.....1028
  - link-speed statement
    - usage guidelines.....144
  - linktrace
    - database, displaying.....1735
    - tracing.....1863
  - linktrace statement.....1022
  - LLDP
    - configuration statements.....1205
    - configuring.....316
    - displaying.....1699
    - example.....319

|                                                 |            |                                              |            |
|-------------------------------------------------|------------|----------------------------------------------|------------|
| local information, displaying.....              | 1702       | loopback, configuring local                  |            |
| neighbor                                        |            | Fast Ethernet interfaces .....               | 789        |
| clearing.....                                   | 1269       | Gigabit Ethernet interfaces.....             | 789        |
| neighbors, displaying.....                      | 1705       | loopback, creating physical                  |            |
| overview.....                                   | 315        | Fast Ethernet interfaces .....               | 788        |
| port description TLV                            |            | Gigabit Ethernet interfaces .....            | 788        |
| configuring.....                                | 1121       | loopback, plug.....                          | 788        |
| port ID TLV                                     |            | loss-priority statement.....                 | 1043       |
| configuring.....                                | 1124       | usage guidelines.....                        | 467        |
| remote global statistics, displaying.....       | 1711       | loss-threshold statement.....                | 1043       |
| statistics                                      |            | lowest-priority-defect statement.....        | 1044       |
| clearing.....                                   | 1270       |                                              |            |
| statistics, displaying.....                     | 1713       | <b>M</b>                                     |            |
| tracing operations.....                         | 320        | MAC address accounting                       |            |
| lldp statement                                  |            | Gigabit Ethernet IQ interfaces.....          | 457        |
| LLDP.....                                       | 1032       | MAC address filtering                        |            |
| lldp-configuration-notification-interval        |            | Gigabit Ethernet IQ interfaces.....          | 469        |
| statement.....                                  | 1033       | mac address for irb.....                     | 306        |
| lmi statement                                   |            | MAC addresses                                |            |
| Ethernet OAM.....                               | 1034       | management Ethernet interface.....           | 27         |
| load-balance.....                               | 1035       | MAC database, displaying.....                | 1675       |
| local-address statement                         |            | MAC filtering on PTX Series Packet Transport |            |
| BFD                                             |            | Routers                                      |            |
| LAG.....                                        | 899        | configuring.....                             | 15         |
| local-loopback statement.....                   | 1038       | MAC flush.....                               | 560        |
| lockout statement.....                          | 1038       | mac statement.....                           | 1045       |
| log files                                       |            | irb interfaces.....                          | 1045       |
| number of PPPoE.....                            | 339, 340   | usage guidelines.....                        | 27         |
| size of PPPoE.....                              | 339, 340   | mac-address statement                        |            |
| log-and-generate-ais statement.....             | 1039       | Accept Source Mac.....                       | 1046       |
| logical devices.....                            | 140        | mac-learn-enable statement.....              | 1048       |
| logical interfaces                              |            | usage guidelines.....                        | 457        |
| VLAN IDs.....                                   | 1237, 1242 | mac-radius statement                         |            |
| VLAN-bundled                                    |            | 802.1X.....                                  | 1049       |
| dual-tag.....                                   | 1248       | mac-validate statement.....                  | 1050       |
| single-tag.....                                 | 1239       | Maintenance Intermediate Points.....         | 526        |
| logical systems                                 |            | MIP.....                                     | 526        |
| configuration statements.....                   | 839        | maintenance-association statement.....       | 1052       |
| logical-interface-policer statement.....        | 1040       | maintenance-domain statement.....            | 1053       |
| loopback comand.....                            | 1042       | mip-half-function.....                       | 1066       |
| loopback mode.....                              | 17         | virtual-switch.....                          | 1236       |
| loopback statement                              |            | major-ring-name statement.....               | 1054, 1086 |
| Aggregated Ethernet, Fast Ethernet, and Gigabit |            | management Ethernet interface                |            |
| Ethernet.....                                   | 1041       | IP address.....                              | 26         |
| Fast Ethernet interfaces                        |            | link modes.....                              | 12         |
| usage guidelines.....                           | 17         | MAC address.....                             | 27         |
| Gigabit Ethernet interfaces                     |            | speed.....                                   | 8          |
| usage guidelines.....                           | 17         | manual switch statement.....                 | 1055       |
| loopback testing.....                           | 771        |                                              |            |

|                                                |           |
|------------------------------------------------|-----------|
| manuals                                        |           |
| comments on.....                               | xlvi      |
| master-only statement.....                     | 1055      |
| usage guidelines.....                          | 26        |
| max-sessions statement                         |           |
| PPPoE service name tables.....                 | 1056      |
| max-sessions-vs-a-ignore statement             |           |
| static and dynamic PPPoE.....                  | 1057      |
| maximum-links command.....                     | 1058      |
| maximum-links statement                        |           |
| usage guidelines.....                          | 140       |
| maximum-requests statement.....                | 1059      |
| mc-ae statement.....                           | 1060      |
| measurement-type statement.....                | 1062      |
| mep statement.....                             | 1063      |
| minimum links for aggregation                  |           |
| Ethernet links.....                            | 145       |
| minimum-interval statement                     |           |
| BFD                                            |           |
| LAG.....                                       | 899       |
| minimum-links statement.....                   | 1065      |
| usage guidelines.....                          | 145       |
| minimum-receive-interval statement             |           |
| BFD                                            |           |
| LAG.....                                       | 899       |
| minimum-receive-ttl statement                  |           |
| BFD                                            |           |
| LAG.....                                       | 899       |
| mip-half-function statement.....               | 1066      |
| mixed VLAN tagging.....                        | 970, 1077 |
| monitor ethernet delay-measurement             |           |
| command.....                                   | 1282      |
| monitor ethernet loss-measurement              |           |
| command.....                                   | 1287      |
| monitor ethernet synthetic-loss-measurement    |           |
| command.....                                   | 1292      |
| monitor interface command                      |           |
| Fast Ethernet interfaces .....                 | 784       |
| Gigabit Ethernet interfaces.....               | 784       |
| monitor-end-point statement                    |           |
| monitor-end-point.....                         | 1068      |
| mtu statement.....                             | 1070      |
| multi-chassis link aggregation interface       |           |
| displaying.....                                | 1680      |
| multi-chassis-protection                       |           |
| peer statement.....                            | 1110      |
| multi-chassis-protection statement.....        | 1075      |
| multicast-router-interface statement           |           |
| IGMP snooping.....                             | 1074      |
| multicast-statistics statement                 |           |
| usage guidelines                               |           |
| aggregated Ethernet.....                       | 201       |
| Ethernet.....                                  | 20        |
| multichassis aggregated Ethernet interfaces    |           |
| reverting to the primary link                  |           |
| immediately.....                               | 1296      |
| reverting to the primary link in non-revertive |           |
| mode.....                                      | 1296      |
| multimode fiber cable.....                     | 785       |
| multiplier statement                           |           |
| BFD                                            |           |
| LAG.....                                       | 899       |
| MX Series                                      |           |
| Ethernet OAM.....                              | 518       |
| MX Series Routers.....                         | 4         |
| <b>N</b>                                       |           |
| name-format statement.....                     | 1076      |
| native-vlan-id statement.....                  | 1077      |
| negotiate-address statement.....               | 1078      |
| usage guidelines.....                          | 331       |
| negotiation-options                            |           |
| allow-remote-loopback statement.....           | 875       |
| no-allow-link-events statement.....            | 1080      |
| negotiation-options statement.....             | 1079      |
| neighbor                                       |           |
| LLDP.....                                      | 1269      |
| no-adaptation statement                        |           |
| BFD                                            |           |
| LAG.....                                       | 899       |
| no-allow-link-events statement.....            | 1080      |
| no-asynchronous-notification statement.....    | 878       |
| no-auto-mdix statement.....                    | 1081      |
| no-flow-control statement.....                 | 971       |
| usage guidelines.....                          | 11        |
| no-gratuitous-arp-reply statement.....         | 981       |
| usage guidelines.....                          | 18        |
| no-gratuitous-arp-request statement.....       | 1081      |
| usage guidelines.....                          | 18        |
| no-keepalives statement.....                   | 1082      |
| no-loopback statement.....                     | 1041      |
| usage guidelines.....                          | 17        |
| no-mac-learn-enable statement.....             | 1048      |
| usage guidelines.....                          | 457       |
| no-odu-backward-frr-enable.....                | 1083      |
| no-odu-signal-degrade-monitor-enable.....      | 1083      |
| no-reauthentication statement.....             | 1084      |

|                                    |      |
|------------------------------------|------|
| no-send-pads-ac-info statement     |      |
| PPPoE.....                         | 1085 |
| no-source-filtering statement..... | 1181 |
| usage guidelines.....              | 469  |
| non-revertive statement.....       | 1086 |
| non-vc-mode statement.....         | 1087 |
| normal (tracing flag)              |      |
| arp aging timer.....               | 19   |
| number-of-frames statement.....    | 1088 |

## O

### OAM

|                                        |               |
|----------------------------------------|---------------|
| configuration statements.....          | 847           |
| E-LMI.....                             | 540           |
| Ethernet CFM.....                      | 577, 580, 583 |
| Ethernet overview.....                 | 518           |
| OAM state                              |               |
| clearing.....                          | 1277          |
| oam statement.....                     | 1091          |
| OAM statistics                         |               |
| clearing.....                          | 1278          |
| oc192 statement.....                   | 1093          |
| odu-backward-frr-enable.....           | 1094          |
| odu-delay-management statement.....    | 1094          |
| bypass.....                            | 901           |
| number-of-frames.....                  | 1088          |
| start-measurement.....                 | 1189          |
| odu-signal-degrade statement.....      | 1095          |
| odu-signal-degrade-monitor-enable..... | 1096          |
| odu-ttim-action-enable statement.....  | 1096          |
| optical attenuation.....               | 793           |
| optics-options statement.....          | 1097          |
| alarm.....                             | 874           |
| bytes.....                             | 902           |
| fec.....                               | 968           |
| is-ma.....                             | 1012          |
| laser-enable.....                      | 1019          |
| line-loopback.....                     | 1022          |
| local-loopback.....                    | 1038          |
| odu-delay-management.....              | 1094          |
| odu-signal-degrade.....                | 1095          |
| odu-ttim-action-enable.....            | 1096          |
| otu-ttim-action-enable.....            | 1099          |
| prbs.....                              | 1140          |
| preemptive-fast-reroute.....           | 1141          |
| rate.....                              | 1148          |
| signal-degrade.....                    | 894, 1177     |
| trigger.....                           | 1220          |

|                                       |      |
|---------------------------------------|------|
| tti.....                              | 1225 |
| warning.....                          | 1252 |
| otn-options statement.....            | 1098 |
| otu-ttim-action-enable statement..... | 1099 |
| otu2 statement.....                   | 1093 |
| otu4 statement.....                   | 1100 |
| output-policer statement.....         | 1101 |
| output-priority-map statement.....    | 1102 |
| usage guidelines.....                 | 467  |
| output-three-color statement.....     | 1103 |
| output-vlan-map statement             |      |
| Aggregated Ethernet.....              | 1104 |
| Gigabit Ethernet IQ.....              | 1105 |

## P

|                                          |            |
|------------------------------------------|------------|
| packets (tracing flag).....              | 19         |
| pado-advertise statement.....            | 1106       |
| parentheses, in syntax descriptions..... | xlvi       |
| pass-through statement.....              | 1106       |
| passive-monitor-mode statement.....      | 1107       |
| path-database-size statement.....        | 1108       |
| pdu-interval statement.....              | 1108       |
| pdu-threshold statement.....             | 1109       |
| peer statement.....                      | 1110       |
| per-flow, stateful statement             |            |
| aggregated Ethernet.....                 | 1037, 1109 |
| per-packet.....                          | 1035       |
| performance-monitoring statement.....    | 1111       |
| periodic statement.....                  | 1112       |
| physical devices, aggregating.....       | 140        |
| physical interfaces                      |            |
| Ethernet link aggregation.....           | 126        |
| flow control.....                        | 11         |
| link modes.....                          | 12         |
| loopback mode.....                       | 17         |
| mixed VLAN tagging.....                  | 970, 1077  |
| VLAN tagging.....                        | 1246       |
| physical link down                       |            |
| Fast Ethernet interfaces, table.....     | 792        |
| Gigabit Ethernet interfaces, table.....  | 792        |
| physical link up                         |            |
| Fast Ethernet interfaces.....            | 780, 790   |
| Gigabit Ethernet interfaces.....         | 780, 790   |
| physical loopback                        |            |
| Fast Ethernet interfaces.....            | 788        |
| Gigabit Ethernet interfaces.....         | 788        |

- 
- PICs
    - installed, displaying list.....1301
    - status
      - displaying for a specific PIC.....1481
  - ping interface command
    - Fast Ethernet interfaces.....797
    - Gigabit Ethernet interfaces .....797
  - policer statement
    - CFM firewall.....1113
    - CFM global level.....1114
    - CFM session level.....1115
    - CoS.....1116
    - interface MAC.....1117
    - usage guidelines.....465
  - policing
    - Gigabit Ethernet IQ interfaces.....465, 466
  - pop statement
    - Gigabit Ethernet IQ interfaces.....1118
    - usage guidelines.....494
  - pop-pop statement
    - Gigabit Ethernet IQ interfaces.....1119
    - usage guidelines.....495
  - pop-swap statement
    - Gigabit Ethernet IQ interfaces.....1120
    - usage guidelines.....496
  - port-description-type statement
    - LLDP.....1121
  - port-id-subtype statement
    - LLDP.....1124
  - port-priority statement
    - LACP.....1123
  - port-status-tlv statement.....1125
  - pp0 statement
    - dynamic PPPoE.....1126
  - ppm statement.....1127
  - PPPoE
    - example configuration.....337
    - flags for tracing operations.....340, 341
    - interfaces, displaying.....1644, 1793
    - log file access for tracing operations.....339, 341
    - log file size and number.....339, 340
    - log filenames for tracing operations.....339, 340
    - message severity levels for tracing
      - operations.....341
    - regular expressions for tracing
      - operations.....339, 341
    - service name tables
      - verifying the configuration.....337
    - service name tables, displaying.....1797
    - service name tables, displaying active
      - sessions.....1800
    - statistics
      - displaying.....1802
    - tracing operations.....338
    - underlying interfaces, displaying.....1804
    - version, displaying.....1810
  - PPPoE server
    - example configuration.....337
  - pppoe-options statement.....1128
    - usage guidelines.....331
  - pppoe-underlying-options statement
    - static and dynamic PPPoE.....1129
  - pps.....862
  - prbs statement.....1140
  - preemptive-fast-reroute statement.....1141
    - backward-frr-enable.....889
    - no-odu-backward-frr-enable.....1083
    - no-odu-signal-degrade-monitor-enable.....1083
    - odu-backward-frr-enable.....1094
    - odu-signal-degrade-monitor-enable.....1096
    - signal-degrade-monitor-enable.....1178
  - premium
    - policer.....1131, 1142
  - premium statement
    - output priority map.....1131, 1142
    - usage guidelines.....465, 466, 467
  - priority statement.....1132
    - CFM SLA iterator.....1132
    - OAM connectivity-fault management.....1133
  - Proactive mode
    - overview.....632
  - propagate-tc statement.....1133
  - protect-maintenance-association statement
    - connectivity-fault management.....1143
  - protection group
    - ethernet ring APS.....1812
    - ethernet ring flush-info.....1824
    - ethernet ring interface.....1826
    - ethernet ring node state.....1829
    - ethernet ring statistics.....1833
    - ethernet ring VLANs.....1822, 1837
  - protection group statistics
    - clearing.....1279
  - protection-group
    - configuration statements.....851
  - protection-group statement.....1134
  - protocol statement.....1137
  - protocol-down statement.....1137

|                                                     |            |
|-----------------------------------------------------|------------|
| protocols connections                               |            |
| configuration statements.....                       | 845, 850   |
| protocols dot1x                                     |            |
| configuration statements.....                       | 846        |
| protocols Ethernet Ring Protection                  |            |
| configuration statements.....                       | 851        |
| protocols iccp                                      |            |
| configuration statements.....                       | 846        |
| protocols OAM                                       |            |
| configuration statements.....                       | 847        |
| protocols statement.....                            | 1136       |
| protocols VRRP                                      |            |
| configuration statements.....                       | 847        |
| proxy statement.....                                | 1143       |
| proxy-arp statement.....                            | 1144       |
| pseudowires                                         |            |
| mixed VLAN tagging.....                             | 970        |
| ptopo-configuration-maximum-hold-time               |            |
| statement.....                                      | 1138       |
| ptopo-configuration-trap-interval statement.....    | 1138       |
| push statement                                      |            |
| Gigabit Ethernet IQ interfaces.....                 | 1139, 1145 |
| usage guidelines.....                               | 493        |
| push-push statement                                 |            |
| Gigabit Ethernet IQ interfaces.....                 | 1140, 1146 |
| usage guidelines.....                               | 494        |
| PVLANS                                              |            |
| configuring.....                                    | 910, 1013  |
| <b>Q</b>                                            |            |
| quiet-period statement.....                         | 1147       |
| <b>R</b>                                            |            |
| rate statement.....                                 | 1148       |
| fixed-stuff-bytes.....                              | 969        |
| otu2.....                                           | 1093       |
| otu4.....                                           | 1100       |
| pass-through.....                                   | 1106       |
| real-time monitoring                                |            |
| Ethernet frame delay measurement                    |            |
| (ETH-DM).....                                       | 1282       |
| Ethernet frame loss-measurement                     |            |
| (ETH-LM).....                                       | 1287       |
| Ethernet synthetic frame loss measurement           |            |
| (ETH-SLM).....                                      | 1292       |
| reauthentication statement.....                     | 1149       |
| rebalance statement                                 |            |
| aggregated Ethernet.....                            | 1150       |
| receive-options-packets statement.....              | 1151       |
| receive-ttl-exceeded statement.....                 | 1151       |
| remote MEP with iterator profile                    |            |
| configuration.....                                  | 662        |
| remote statement.....                               | 1152       |
| usage guidelines.....                               | 351        |
| remote-loopback statement.....                      | 1152       |
| remote-maintenance-association statement            |            |
| connectivity-fault management.....                  | 1153       |
| remote-mep statement.....                           | 1153       |
| request interface (revert   switchover) (Aggregated |            |
| Ethernet Link Protection) command.....              | 1298       |
| request interface mc-ae switchover (Multichassis    |            |
| link aggregation) command.....                      | 1296       |
| request lacp link-switchover command.....           | 1299       |
| retries statement.....                              | 1157       |
| revertive statement.....                            | 1158       |
| rewrite VLAN tag on untagged frame                  |            |
| usage guidelines.....                               | 497        |
| ring protection                                     |            |
| Ethernet overview.....                              | 737, 739   |
| ring-id statement.....                              | 1158       |
| ring-protection-link-end statement.....             | 1159       |
| ring-protection-link-owner statement.....           | 1159       |
| RJ-45 Ethernet interface.....                       | 788        |
| routing-instance statement.....                     | 1160       |
| PPPoE service name tables.....                      | 1161       |
| <b>S</b>                                            |            |
| sa-multicast statement.....                         | 1162, 1163 |
| scan-interval.....                                  | 862        |
| send-critical-event statement.....                  | 1167       |
| serial numbers, displaying.....                     | 1300       |
| server statement.....                               | 1167       |
| server-fail statement.....                          | 1168       |
| server-reject-vlan statement.....                   | 1169       |
| server-timeout statement.....                       | 1170       |
| service name tables                                 |            |
| PPPoE                                               |            |
| verifying the configuration.....                    | 337        |
| service statement                                   |            |
| PPPoE.....                                          | 1171       |
| service-level agreement measurement                 |            |
| overview.....                                       | 630        |
| service-name statement.....                         | 1172       |
| usage guidelines.....                               | 331        |
| service-name-table statement                        |            |
| PPPoE underlying interface.....                     | 1173       |
| service-name-tables statement                       |            |
| PPPoE.....                                          | 1174       |

|                                                 |               |                                                  |      |
|-------------------------------------------------|---------------|--------------------------------------------------|------|
| set cli terminal command                        |               | show lldp local-information command.....         | 1702 |
| Fast Ethernet interfaces .....                  | 785           | show lldp neighbors command.....                 | 1705 |
| Gigabit Ethernet interfaces .....               | 785           | show lldp remote-global-statistics command.....  | 1711 |
| set loopback local command                      |               | show lldp statistics command.....                | 1713 |
| Fast Ethernet interfaces .....                  | 789           | show oam ethernet connectivity-fault-management  |      |
| Gigabit Ethernet interfaces .....               | 789           | delay-statistics command.....                    | 1716 |
| short-name-format statement.....                | 1176          | show oam ethernet connectivity-fault-management  |      |
| show chassis hardware command.....              | 1300          | forwarding-state command.....                    | 1720 |
| show chassis pic command.....                   | 1481          | show oam ethernet connectivity-fault-management  |      |
| show interfaces (10-Gigabit Ethernet)           |               | interfaces command.....                          | 1724 |
| command.....                                    | 1603          | show oam ethernet connectivity-fault-management  |      |
| show interfaces (Adaptive Services)             |               | linktrace path-database command.....             | 1735 |
| command.....                                    | 1500          | show oam ethernet connectivity-fault-management  |      |
| show interfaces (Aggregated Ethernet)           |               | loss-statistics command.....                     | 1738 |
| command.....                                    | 1508          | show oam ethernet connectivity-fault-management  |      |
| show interfaces (Fast Ethernet) command.....    | 1563          | mep-database command.....                        | 1742 |
| show interfaces (Gigabit Ethernet)              |               | show oam ethernet connectivity-fault-management  |      |
| command.....                                    | 1579          | mep-statistics command.....                      | 1753 |
| show interfaces (M Series, MX Series, T Series  |               | show oam ethernet connectivity-fault-management  |      |
| Routers, PTX Series Management and Internal     |               | path-database command.....                       | 1764 |
| Ethernet) command.....                          | 1628          | show oam ethernet connectivity-fault-management  |      |
| show interfaces (PPPoE) command.....            | 1644          | policer command.....                             | 1766 |
| show interfaces command                         |               | show oam ethernet connectivity-fault-management  |      |
| Fast Ethernet interfaces .....                  | 780, 790, 798 | sla-iterator-statistics command.....             | 1769 |
| Gigabit Ethernet interfaces .....               | 780, 790      | show oam ethernet connectivity-fault-management  |      |
| show interfaces demux0 (Demux Interfaces)       |               | synthetic-loss-statistics command.....           | 1774 |
| command.....                                    | 1519          | show oam ethernet fnp interface.....             | 1778 |
| show interfaces diagnostics optics (Gigabit     |               | show oam ethernet fnp messages.....              | 1779 |
| Ethernet) command.....                          | 1528          | show oam ethernet fnp status.....                | 1781 |
| show interfaces extensive command               |               | show oam ethernet link-fault-management          |      |
| Fast Ethernet interfaces.....                   | 781, 801      | command.....                                     | 1783 |
| Gigabit Ethernet interfaces.....                | 781           | show pppoe interfaces command.....               | 1793 |
| show interfaces far-end-interval.....           | 1561          | show pppoe service-name-tables command.....      | 1797 |
| show interfaces interface-set command.....      | 1654          | show pppoe sessions command.....                 | 1800 |
| show interfaces interface-set queue             |               | show pppoe statistics command.....               | 1802 |
| command.....                                    | 1657          | show pppoe underlying-interfaces                 |      |
| show interfaces interval command.....           | 1665          | command.....                                     | 1804 |
| show interfaces irb command.....                | 1669          | show pppoe version command.....                  | 1810 |
| show interfaces mac-database (Gigabit Ethernet) |               | show protection-group ethernet-ring aps          |      |
| command.....                                    | 1675          | command.....                                     | 1812 |
| show interfaces mc-ae.....                      | 1680          | show protection-group ethernet-ring data-channel |      |
| show interfaces terse command                   |               | command.....                                     | 1822 |
| Fast Ethernet interfaces .....                  | 778           | show protection-group ethernet-ring flush-info   |      |
| Gigabit Ethernet interfaces.....                | 779           | command.....                                     | 1824 |
| show interfaces transport pm statement.....     | 1683          | show protection-group ethernet-ring interface    |      |
| show l2-learning instance command.....          | 1689          | command.....                                     | 1826 |
| show l2-learning redundancy-groups.....         | 1691          | show protection-group ethernet-ring node-state   |      |
| show lacp interfaces command.....               | 1695          | command.....                                     | 1829 |
| show lldp command.....                          | 1699          |                                                  |      |

|                                                      |                 |
|------------------------------------------------------|-----------------|
| show protection-group ethernet-ring statistics       |                 |
| command.....                                         | 1833            |
| show protection-group ethernet-ring vlan             |                 |
| command.....                                         | 1837            |
| show vrrp command.....                               | 1851            |
| signal-degrade statement.....                        | 894, 1177       |
| ber-threshold-signal-degrade .....                   | 896             |
| interval.....                                        | 1010            |
| signal-degrade-monitor-enable.....                   | 1178            |
| single-mode fiber cable.....                         | 785             |
| sla-iterator-profile statement.....                  | 1184            |
| usage guidelines.....                                | 662             |
| sla-iterator-profiles statement.....                 | 1185            |
| sonet statement                                      |                 |
| usage guidelines.....                                | 140             |
| source-address-filter statement.....                 | 1180            |
| source-filtering statement.....                      | 1181            |
| usage guidelines.....                                | 469             |
| specifications for fiber-optic, table.....           | 785             |
| Specifying the Interface Over Which VPN Traffic      |                 |
| Travels to the CE Router.....                        | 249, 251        |
| Specifying the Interface to Handle Traffic for a     |                 |
| CCC.....                                             | 249, 261        |
| Specifying the Interface to Handle Traffic for a CCC |                 |
| Connected to the Layer 2 Circuit.....                | 258, 262        |
| speed statement                                      |                 |
| Ethernet.....                                        | 1182            |
| MX Series DPC.....                                   | 1183            |
| usage guidelines.....                                | 8               |
| stacked VLAN-tag framing                             |                 |
| VLAN ID list.....                                    | 1250            |
| stacked-vlan-tagging statement.....                  | 1186            |
| start-measurement statement.....                     | 1189            |
| startup-silent-period statement                      |                 |
| usage guidelines.....                                | 324             |
| state (tracing flag).....                            | 19              |
| stateful load-balancing states                       |                 |
| clearing for aggregated Ethernet                     |                 |
| interface.....                                       | 1266, 1267      |
| stateful statement                                   |                 |
| aggregated Ethernet.....                             | 1036            |
| statement-name statement.....                        | 905, 1164, 1175 |
| static address resolution protocol.....              | 793             |
| static PPPoE statements                              |                 |
| max-sessions-vsa-ignore.....                         | 1057            |
| pppoe-underlying-options.....                        | 1129            |
| static statement.....                                | 1187            |
| static subscribers                                   |                 |
| max-sessions-vsa-ignore statement.....               | 1057            |
| pppoe-underlying-options statement.....              | 1129            |
| static-interface statement                           |                 |
| PPPoE.....                                           | 1188            |
| statistic error                                      |                 |
| Fast Ethernet interfaces.....                        | 798             |
| statistics                                           |                 |
| Ethernet frame delay.....                            | 734, 735        |
| Fast Ethernet interfaces .....                       | 784             |
| resetting.....                                       | 797             |
| Gigabit Ethernet interfaces .....                    | 784             |
| resetting.....                                       | 797             |
| interface set                                        |                 |
| clearing.....                                        | 1262            |
| LLDP.....                                            | 1270            |
| status                                               |                 |
| Fast Ethernet interfaces.....                        | 778, 790        |
| Gigabit Ethernet interfaces .....                    | 790             |
| status description, table                            |                 |
| Fast Ethernet interfaces.....                        | 778             |
| Gigabit Ethernet interfaces.....                     | 779             |
| status extensive                                     |                 |
| Fast Ethernet interfaces.....                        | 781             |
| Gigabit Ethernet interfaces .....                    | 781             |
| status for specific interface                        |                 |
| Fast Ethernet.....                                   | 780             |
| Gigabit Ethernet .....                               | 780             |
| subscriber interface statements                      |                 |
| access-concentrator.....                             | 856             |
| max-sessions-vsa-ignore.....                         | 1057            |
| pp0.....                                             | 1126            |
| pppoe-underlying-options.....                        | 1129            |
| supplicant statement.....                            | 1190            |
| single (mode).....                                   | 1189            |
| supplicant-timeout statement.....                    | 1191            |
| support, technical See technical support             |                 |
| swap statement                                       |                 |
| Gigabit Ethernet IQ interfaces.....                  | 1192            |
| swap-by-poppush statement.....                       | 511             |
| Gigabit Ethernet IQ2 and IQ2E interfaces.....        | 1192            |
| swap-push statement                                  |                 |
| Gigabit Ethernet IQ interfaces.....                  | 1193            |
| usage guidelines.....                                | 501             |
| swap-swap statement                                  |                 |
| Gigabit Ethernet IQ interfaces.....                  | 1194            |
| usage guidelines.....                                | 502             |
| switch-options statement.....                        | 1194            |



- switch-port statement
  - access switching.....1195
- symbol-period statement.....1196
- Symmetrical Load Balancing
  - on 802.3ad Link Aggregation on MX
    - Series.....160
- syntax conventions.....xlv
- system processes
  - configuration statements.....853
- system-priority statement
  - LACP.....1198
- T**
  - tag protocol IDs on PTX Series Packet Transport
    - Routers
      - configuring.....488
  - tag-protocol-id statement
    - TPID to rewrite.....1200
    - TPIDs expected to be sent or received.....1199
  - tca statement.....1201
  - technical support
    - contacting JTAC.....xlvii
  - terminate statement
    - PPPoE service name tables.....1203
  - timer (tracing flag)
    - Ethernet interface speed.....19
  - tolerance.....862
  - trace operations
    - VRRP.....19
  - traceoptions statement.....1215
    - ICCP.....988
    - interface processes.....1208
    - LACP.....1210
    - LLDP.....1204
      - usage guidelines.....320
    - PPPoE.....1212
    - VRRP
      - usage guidelines.....19
  - traceroute ethernet.....1863
  - traceroute ethernet command.....1863
  - tracing operations
    - LLDP.....320, 1204
    - PPPoE.....338
  - transmit light level.....785
  - transmit-delay statement
    - LLDP.....1216
  - transmit-interval statement
    - BFD
      - LAG.....899
  - transmit-period statement.....1218
  - transparent statement.....511
  - transparent tag operations.....509
  - transport-monitoring statement.....1219
  - Tri-Rate Ethernet copper interfaces
    - speed.....8
  - trigger statement.....1220
  - trunk interface
    - interface-mode statement.....252
    - usage guidelines.....253
    - vlan-id-list statement.....253
  - trunk port.....253
    - VLAN ID list.....1241
  - tti statement.....1225
  - tx-power statement.....1226
- U**
  - uac-policy statement.....1226
  - underlying-interface statement.....1227
  - unit statement.....1228
  - unnumbered-address statement
    - PPP.....1234
  - unnumbered-interface statement
    - usage guidelines.....331
- V**
  - version statement
    - BFD
      - LAG.....899
  - version-3 statement.....1235
  - virtual links
    - aggregated devices.....140
  - virtual-control-channel statement.....1236
  - virtual-switch statement.....1236
  - VLAN
    - Configuring a Layer 2 Circuit on a
      - VLAN-Bundled Logical Interface.....257
    - Configuring a VLAN-Bundled Logical
      - Interface.....256, 257
    - Configuring Logical Link-Layer Encapsulation
      - to Support CCCs.....260
    - Configuring VLAN ID List-Bundled Logical
      - Interfaces That Connect CCCs.....260
    - Specifying the Interface Over Which VPN
      - Traffic Travels to the CE Router.....249, 251
    - Specifying the Interface to Handle Traffic for a
      - CCC.....249, 261
    - VLAN IDs.....1242
    - values, listed by Ethernet interface type.....237

|                                             |      |
|---------------------------------------------|------|
| VLAN tagging.....                           | 1246 |
| VLAN tagging on PTX Series Packet Transport |      |
| Routers                                     |      |
| configuring.....                            | 241  |
| vlan-assignment statement.....              | 1237 |
| vlan-id statement                           |      |
| 802.1Q VLANs.....                           | 1237 |
| Ethernet interfaces.....                    | 1237 |
| Gigabit Ethernet interfaces                 |      |
| usage guidelines.....                       | 246  |
| rewriting at ingress or egress.....         | 1238 |
| vlan-id-list statement                      |      |
| bridge domain.....                          | 1241 |
| Ethernet VLAN circuit.....                  | 1239 |
| usage guidelines.....                       | 253  |
| vlan-id-range statement.....                | 1242 |
| Ethernet interfaces.....                    | 1242 |
| vlan-rewrite statement.....                 | 1243 |
| vlan-rule statement.....                    | 1244 |
| vlan-steering statement.....                | 1245 |
| vlan-tagging statement.....                 | 1246 |
| vlan-tags statement                         |      |
| dual-tag framing.....                       | 1248 |
| dynamic profiles.....                       | 1247 |
| Gigabit Ethernet interfaces                 |      |
| usage guidelines.....                       | 246  |
| stacked VLAN tags.....                      | 1250 |
| usage guidelines.....                       | 489  |
| VPLS                                        |      |
| statistical frame loss measurement.....     | 663  |
| VRRP                                        |      |
| configuration statements.....               | 847  |
| statistics                                  |      |
| displaying.....                             | 1851 |
| trace operations.....                       | 19   |
| tracing flag.....                           | 19   |
| vrrp                                        |      |
| failover-delay.....                         | 961  |
| version-3.....                              | 1235 |

## W

|                                       |      |
|---------------------------------------|------|
| wait-to-block-interval statement..... | 1251 |
| warning statement.....                | 1252 |
| wavelength statement.....             | 1253 |
| weighted random early detection.....  | 20   |
| west-interface statement.....         | 1257 |
| WRED.....                             | 20   |